

umbrella2

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1 Namespace Documentation

1.1 ImagingToolkit Namespace Reference

Namespaces

- namespace [ImagelO](#)

1.2 ImagingToolkit.ImagelO Namespace Reference

Classes

- class [ByteBitmap](#)
Bitmap with a byte backend; based on Windows Bitmaps.

1.3 Umbrella2 Namespace Reference

Namespaces

- namespace [Algorithms](#)
- namespace [Framework](#)
- namespace [IO](#)
- namespace [Pipeline](#)
- namespace [Plugins](#)
- namespace [PropertyModel](#)
- namespace [SharedBase](#)
- namespace [Utils](#)
- namespace [Visualizer](#)
- namespace [Visualizers](#)
- namespace [WCS](#)

Classes

- struct [EquatorialPoint](#)
Point representing a point on the equatorial coordinate system.
- class [EquatorialPointStringFormatter](#)
Converts EquatorialPoints to strings and back.
- struct [EquatorialVelocity](#)
Velocity in the equatorial coordinate system.
- class [ImageDetection](#)
The detection on an image of an object.
- struct [PixelPoint](#)
Point representing a pixel coordinate.

- struct [PixelVelocity](#)
Velocity in pixel coordinates. Values in units per second.
- struct [Position](#)
Represents an object position.
- struct [ProjectionPoint](#)
Point representing a projection plane coordinate.
- struct [ProjectionVelocity](#)
Velocity in projection plane coordinates.
- class [StandardDetectionFactory](#)
A set of standard methods of creating ImageDetections.
- class [StandardTrackletFactory](#)
A set of standard methods for creating Tracklets.
- class [Tracklet](#)
An object candidate.
- class [TrackletVelocity](#)
Represents the velocity of a tracklet.

1.4 Umbrella2.Algorithms Namespace Reference

Namespaces

- namespace [DataStructures](#)
- namespace [Detection](#)
- namespace [Filtering](#)
- namespace [Geometry](#)
- namespace [Images](#)
- namespace [Misc](#)
- namespace [Pairing](#)
- namespace [Schedulers](#)
- namespace [Tools](#)

1.5 Umbrella2.Algorithms.DataStructures Namespace Reference

Classes

- class [SphericalQuadTree](#)
Data structure for fast retrieval of objects by their coordinates in a spherical coordinate system.

1.6 Umbrella2.Algorithms.Detection Namespace Reference

Classes

- class [ApproxRecover](#)
Provides functions for recovering tracklets and detections on a (different) set of images.
- class [DotDetector](#)
Connected component hysteresis algorithm for light source detection.
- class [PoolMDMerger](#)
Holds detections and performs merging of source detections in tracklets.
- class [TrackletsDeduplication](#)

1.7 Umbrella2.Algorithms.Filtering Namespace Reference

Classes

- class [BadzoneFilter](#)
Filters detections in bad image areas.
- class [BrightnessThicknessFilter](#)
Filters out sources which are too bright for their thickness. Used mainly for preventing white bands from being interpreted as sources.
- class [Helper](#)
- interface [IImageDetectionFilter](#)
- class [ImageDetectionFilterTools](#)
Provides filtering for sources.
- interface [ITrackletFilter](#)
- class [LinearityTest](#)
Linearity filter for tracklets.
- class [LinearityThresholdFilter](#)
Checks that the detection is thin enough on the semiminor axis.
- struct [Star](#)
Represents a fixed star; used for filtering.
- class [StarData](#)
Class representing information about fixed stars. Used for filtering.
- class [TrackletFilters](#)
Provides filtering for tracklets.

1.8 Umbrella2.Algorithms.Geometry Namespace Reference

Classes

- class [LineIntersection](#)
Class for computing intersections between lines.
- struct [Vector](#)
2D vector.

1.9 Umbrella2.Algorithms.Images Namespace Reference

Namespaces

- namespace [ImageCombine](#)
- namespace [Median](#)
- namespace [Normalization](#)
- namespace [Schedulers](#)

Classes

- class [BadpixelFilter](#)
Support for badpixel removal. Currently removes badpixels by masking.
- class [BasicImstatSolver](#)
Simple solver for producing [ImageStatistics](#).
- class [CoreFilter](#)
- class [HardMedians](#)
Class of strict median filtering algorithms.
- class [ImageStatistics](#)
Contains a set of information about the image.
- class [LineAnalyzer](#)
Algorithm that analyzes line using a hysteresis connected component algorithm for detecting luminous blobs and merges the blobs into line segments.
- class [LongTrailDetector](#)
The new long trail detection mechanism, replacing [SegmentDetector](#). Versatile and documented.
- class [MaskByMedian](#)
Class for filtering out static light sources by means of a mask obtained from the median image.
- class [RestrictedMean](#)
Class containing filtering algorithms that combine median filtering with averaging.
- class [RLHT](#)
- class [SchedCore](#)
Algorithm scheduling core interface.

1.10 Umbrella2.Algorithms.Images.ImageCombine Namespace Reference

Classes

- class [MinFilters](#)
Class for minimum-value filtering of multiple images.

1.11 Umbrella2.Algorithms.Images.Median Namespace Reference

Classes

- class [EstimatorFR](#)
A median computation method that applies a Floyd-Rivest partitioning using estimated pivots before applying Quickselect.
- class [MedianSelection](#)
Implements quickselect for weighted medians.
- class [SkippedMedian](#)

1.12 Umbrella2.Algorithms.Images.Normalization Namespace Reference

Classes

- class [Point4Distance](#)
An image brightness uniformization algorithm that interpolates background intensity by the distance to the points in a mesh of medians.

1.13 Umbrella2.Algorithms.Images.Schedulers Namespace Reference

Classes

- class [CPUParallel](#)
- class [SchedUtil](#)
Useful functions for implementing schedulers.

1.14 Umbrella2.Algorithms.Misc Namespace Reference

Classes

- class [ConnectedComponentGraph](#)
Graph data structure to find groupings of objects.
- class [LinearRegression](#)
Provides linear regression functions.
- class [LineFit](#)
Fits a line to a set of points. Note that this assumes errors only in the Y-axis.
- class [MTPool](#)
Multithreaded object pool.
- class [QuadTree](#)
A [QuadTree](#) (2-d tree) for quickly identifying objects in a given neighborhood.

1.15 Umbrella2.Algorithms.Pairing Namespace Reference

Classes

- class [DetectionReducer](#)
Provides support for removing fixed stars from a set of detections.
- class [LinePoolSimple](#)
A [MDPoolCore](#) algorithm that works by considering line fitting residuals.
- class [MDPoolCore](#)
Class of common code for [Pool Algorithms](#).
- class [PrePair](#)
Attempts to merge detections that appear to be the same object.

1.16 Umbrella2.Algorithms.Schedulers Namespace Reference

Classes

- struct [AlgorithmRunParameters](#)
Common algorithm parameters. Usually specified by algorithm type.
- class [ExtensionMethods](#)
- struct [ImageSegmentPosition](#)
Represents the position of a block of data w.r.t. the image.
- struct [RunDetails](#)
Bag of data for the algorithm run.

Functions

- delegate void [DirectPixelMap](#)< T > (double[,] Input, double[,] Output, T Extra)
Delegate for a transform that maps one input image to an output image with one extra argument.
- delegate void [IndirectPixelMap](#)< T > (double[,] Input, double[,] Output, [ImageSegmentPosition](#) InputPosition, [ImageSegmentPosition](#) OutputPosition, T Extra)
Delegate for a transform that maps one input image to an output image using pixel position information.
- delegate void [WcsMap](#)< T > (double[,] Input, double[,] Output, [ImageSegmentPosition](#) InputPosition, [ImageSegmentPosition](#) OutputPosition, T Extra)
Delegate for a transform that maps one input image to an output image using pixel position information.
- delegate void [PixelCombiner](#)< T > (double[,][] Inputs, double[,] Output, [ImageSegmentPosition](#)[] InputPositions, [ImageSegmentPosition](#) OutputPosition, T Extra)
Delegate for a transform that maps multiple input images to an output image with one extra argument.
- delegate void [WcsCombiner](#)< T > (double[,][] Inputs, double[,] Output, [ImageSegmentPosition](#)[] InputPositions, [ImageSegmentPosition](#) OutputPosition, T Extra)
Delegate for a transform that maps multiple input images to an output image with one extra argument.
- delegate void [Extractor](#)< T > (double[,] Input, [ImageSegmentPosition](#) InputPosition, T Extra)
Delegate for a transform that reads data from an input image with one extra argument.

1.16.1 Function Documentation

[DirectPixelMap](#)< T >()

```
delegate void Umbrella2.Algorithms.Schedulers.DirectPixelMap< T > (
    double Input[,],
    double Output[,],
    T Extra)
```

Delegate for a transform that maps one input image to an output image with one extra argument.

Template Parameters

<i>T</i>	Type of the argument passed.
----------	------------------------------

Parameters

<i>Input</i>	Input image data.
<i>Output</i>	Output image data.
<i>Extra</i>	Passed-through argument.

[Extractor](#)< T >()

```
delegate void Umbrella2.Algorithms.Schedulers.Extractor< T > (
    double Input[,],
    ImageSegmentPosition InputPosition,
    T Extra)
```

Delegate for a transform that reads data from an input image with one extra argument.

The extra argument typically collects the results.

Template Parameters

<i>T</i>	Type of the extra argument.
----------	-----------------------------

Parameters

<i>Input</i>	Input image data.
<i>InputPosition</i>	Position of the input data w.r.t. the input image.
<i>Extra</i>	Passed-through argument.

IndirectPixelMap< T >()

```
delegate void Umbrella2.Algorithms.Schedulers.IndirectPixelMap< T > (
    double Input[,],
    double Output[,],
    ImageSegmentPosition InputPosition,
    ImageSegmentPosition OutputPosition,
    T Extra)
```

Delegate for a transform that maps one input image to an output image using pixel position information.

Template Parameters

<i>T</i>	Type of the extra argument.
----------	-----------------------------

Parameters

<i>Input</i>	Input image data.
<i>Output</i>	Output image data.
<i>InputPosition</i>	Position of the input data w.r.t. the input image.
<i>OutputPosition</i>	Position of the output data w.r.t. the output image.
<i>Extra</i>	

PixelCombiner< T >()

```
delegate void Umbrella2.Algorithms.Schedulers.PixelCombiner< T > (
    double Inputs[][][,],
    double Output[,],
    ImageSegmentPosition[] InputPositions,
    ImageSegmentPosition OutputPosition,
    T Extra)
```

Delegate for a transform that maps multiple input images to an output image with one extra argument.

Template Parameters

<i>T</i>	Type of the extra argument.
----------	-----------------------------

Parameters

<i>Inputs</i>	Input images data.
<i>Output</i>	Output image data.
<i>InputPositions</i>	Positions of the input data w.r.t. the input images.
<i>OutputPosition</i>	Position of the output data w.r.t. the output image.
<i>Extra</i>	Passed-through argument.

WcsCombiner< T >()

```
delegate void Umbrella2.Algorithms.Schedulers.WcsCombiner< T > (
    double Inputs[[],],
    double Output[[],],
    ImageSegmentPosition[] InputPositions,
    ImageSegmentPosition OutputPosition,
    T Extra)
```

Delegate for a transform that maps multiple input images to an output image with one extra argument.

Template Parameters

<i>T</i>	Type of the extra argument.
----------	-----------------------------

Parameters

<i>Inputs</i>	Input images data.
<i>Output</i>	Output image data.
<i>InputPositions</i>	Positions of the input data w.r.t. the input images.
<i>OutputPosition</i>	Position of the output data w.r.t. the output image.
<i>Extra</i>	Passed-through argument.

WcsMap< T >()

```
delegate void Umbrella2.Algorithms.Schedulers.WcsMap< T > (
    double Input[[],],
    double Output[[],],
    ImageSegmentPosition InputPosition,
    ImageSegmentPosition OutputPosition,
    T Extra)
```

Delegate for a transform that maps one input image to an output image using pixel position information.

Template Parameters

<i>T</i>	Type of the extra argument.
----------	-----------------------------

Parameters

<i>Input</i>	Input image data.
<i>Output</i>	Output image data.
<i>InputPosition</i>	Position of the input data w.r.t. the input image.
<i>OutputPosition</i>	Position of the output data w.r.t. the output image.
<i>Extra</i>	

1.17 Umbrella2.Algorithms.Tools Namespace Reference

Classes

- class [PhotometryAperture](#)
Aperture photometry tool. Measures intensity of an area of the image relative to its surrounding area.

1.18 Umbrella2.Framework Namespace Reference

Classes

- class [RWLockArea](#)
Provides readers-writers lock for images.

1.19 Umbrella2.IO Namespace Reference

Namespaces

- namespace [FITS](#)

Classes

- interface [IBackingFile](#)
Represent a file backing an [Image](#).
- class [ICHV](#)
[Image](#) Core Header Values. A wrapper for the core data in [Images](#)' header data.
- class [Image](#)
- struct [ImageData](#)
[Image](#) data from a [FITS](#) File. The data is in the form [y, x].
- class [ImageProperties](#)
Represents a set of image properties that can be parsed from image metadata.
- class [ImageTiming](#)
Holds the observation time information of the associated [Image](#).
- class [MetadataRecord](#)
[Image](#) metadata record. [Image](#) properties can be extracted from it.
- class [UmbrellaIOException](#)
Wrapper for [IO](#) exceptions raised from [Umbrella](#).

1.20 Umbrella2.IO.FITS Namespace Reference

Namespaces

- namespace [Formats](#)
- namespace [KnownKeywords](#)

Classes

- class [FICHV](#)
FITS Image Core Header Values. A wrapper for the core data in FITS Images' header data.
- class [FitsArgumentOutOfRangeException](#)
Exception raised when the value of a header record is outside the allowed or supported set of values.
- class [FitsBuilder](#)
Provides functions for building FITS Images.
- class [FitsDriverException](#)
Represent an internal failure of the FITS handling code that may or may not be due to broken inputs.
- class [FitsFile](#)
A handle to a FITS File on the disk. Used to read/write data.
- class [FitsFileBuilder](#)
- class [FitsFileException](#)
Exceptions thrown from attempting to open or create a FITS file. This exception is raised only for issues with the file structure, that appear when trying to parse the on-disk record data into the in-memory hashmap and the pointers to the primary and extension data arrays and not for exceptions encountered while interpreting the image records (which are raised through [FitsImageException](#)).
- class [FitsImage](#)
Class representing a FITS image from a FITS file.
- class [FitsImageException](#)
Exception raised when trying to parse image data from a FITS file. This exception is raised only for image records; if the file itself is broken, the [FitsFileException](#) is raised instead.
- class [FITSMetadataRecord](#)
- class [FitsNotStandardException](#)
Exception thrown when the input FITS file (or headers provided to the FITS creation function) do not respect the FITS standard.
- class [FitsRecordException](#)
Represents an exception that occurs when parsing a FITS record.
- class [HeaderExtensions](#)
Extension methods for working with FITS headers.
- class [HeaderIO](#)
Contains functions for reading FITS headers.
- class [HeaderTableUtil](#)
- interface [IFitsParsingError](#)
Catch-all for known parsing errors in handling FITS files and images.
- struct [KeywordRecord](#)
FITS Keyword Record. Raw form.
- class [MissingKeywordException](#)
Represents a parsing error where a record with a specific keyword was expected to be present in the file headers, but it was not found.
- class [MMapFitsFile](#)
- class [NSStreamFitsFile](#)
Represents a FITS file that was read from a non-seekable stream. The file is kept in-memory.
- class [UnsupportedFitsValueException](#)
Represents a record that has a value which cannot be handled by the FITS parsing code.

1.21 Umbrella2.IO.FITS.Formats Namespace Reference

Classes

- class [FPDataset](#)

Module for reading from and writing to floating-point *FITS* data arrays. Functions provide for converting memory-mapped file data to IEEE floating point.

- class [IntegerDataset](#)

Module for reading from and writing to floating-point *FITS* data arrays. Functions provide for converting memory-mapped file data to IEEE floating point.

Functions

- delegate void [DataReader](#) (IntPtr Pointer, double[,] Data, int Hstart, int Hend, int Wstart, int Wend, int Stride)
Delegate for reading IEEE floating point data from the memory-mapped image.
- delegate void [DataWriter](#) (IntPtr Pointer, double[,] Data, int Stride)
Delegate for writing IEEE floating point data to the memory-mapped image.

1.21.1 Function Documentation

DataReader()

```
delegate void Umbrella2.IO.FITS.Formats.DataReader (
    IntPtr Pointer,
    double Data[,],
    int Hstart,
    int Hend,
    int Wstart,
    int Wend,
    int Stride)
```

Delegate for reading IEEE floating point data from the memory-mapped image.

Parameters

<i>Pointer</i>	Pointer to image data.
<i>Data</i>	Destination array.
<i>Hstart</i>	Y coordinate from which to start.
<i>Hend</i>	Y coordinate at which to end.
<i>Wstart</i>	X coordinate at which to start.
<i>Wend</i>	X coordinate at which to end.
<i>Stride</i>	Data stride.

DataWriter()

```
delegate void Umbrella2.IO.FITS.Formats.DataWriter (
    IntPtr Pointer,
    double Data[,],
    int Stride)
```

Delegate for writing IEEE floating point data to the memory-mapped image.

Parameters

<i>Pointer</i>	Pointer to image data.
<i>Data</i>	Source array.
<i>Stride</i>	Data stride.

1.22 Umbrella2.IO.FITS.KnownKeywords Namespace Reference

Classes

- class [ObservationTime](#)
Records for specifying the observation time of the frame.
- class [SWarpScaling](#)
Handles scaling of image data according to SWarp headers.

1.23 Umbrella2.Pipeline Namespace Reference

Namespaces

- namespace [EIOAlgorithms](#)
- namespace [ExtraIO](#)
- namespace [Utils](#)

1.24 Umbrella2.Pipeline.EIOAlgorithms Namespace Reference

Classes

- class [SkyBotImageData](#)
SkyBoT pairing data for a given image.
- class [SkyBoTPairing](#)
Provides an algorithm for pairing SkyBoT objects with tracklets.
- class [VizieRCalibration](#)
Provides an algorithm for calibrating image Zero Point using VizieR.

1.25 Umbrella2.Pipeline.ExtraIO Namespace Reference

Namespaces

- namespace [Ades](#)
- namespace [lpef](#)
- namespace [Vizier](#)

Classes

- class [DataTable](#)
- class [FieldParam](#)
- interface [IVotableContainer](#)
- class [MPCOpticalReportFormat](#)
Provides support for working with MPC Optical Reports.
- class [Resource](#)
- class [SkyBoTLookup](#)
Provides an API for accessing the SkyBot services.
- class [SourceExtractor](#)
- class [VizieR](#)
Provides an API for accessing [VizieR](#) services.
- class [VOTableMini](#)
- class [VotableParseException](#)

1.26 Umbrella2.Pipeline.ExtraIO.Ades Namespace Reference**Classes**

- class [AdesConverter](#)
Provides conversion functions from ADES to MPC.
- class [AdesReport](#)
Represents a report (ADES data block), with an individual context and the associated observations.
- class [AdesVersion](#)
ADES document versions.
- class [AdesXml](#)
Umbrella2 ADES representation conversion to and from XML.
- class [Coinvestigators](#)
- class [Collaborators](#)
- class [Comment](#)
- class [ContextGroupAttribute](#)
Represents a group in the observation context. These groups are separate from each other within the observation context.
- class [CoreStructureAttribute](#)
Represents an ADES node that is a core part of an ADES document.
- class [ElementAttribute](#)
An ADES element, which is an individual piece of data.
- class [EntryAttributeXmlAttribute](#)
Represent an XML attribute for an ADES node.
- class [GroupAttribute](#)
Represent an ADES group (of elements, see [ElementAttribute](#)).
- class [IdentificationGroup](#)
The Identification Group includes four elements that are used to identify the object associated with the observation.
- class [LocationGroup](#)
The Location Group (Table 6) includes the elements that are used only for observatories that are not at a fixed position on the surface of the Earth, or do not have a specific MPC-assigned observatory code.
- class [Measurers](#)
- class [ObservationContext](#)
- class [ObservationGroup](#)
The Observation Group encapsulates the astrometry and its associated uncertainty.

- class [ObservationGroupAttribute](#)
Represent a group in an observation entry. These groups are merged together in the observation entry.
- class [Observatory](#)
- class [Observers](#)
- class [OpticalObservation](#)
Entry for an optical observation.
- class [PhotometryGroup](#)
Any photometric observations are reported within the optional Photometry Group.
- class [PrecisionGroup](#)
For observations that were translated from MPC1992 or earlier formats, the Precision Group preserves the precision of the original reported observation and allows the content of the original sexagesimal submission to be derived. The entire group is optional (but not allowed in MPC submissions),.
- class [ResidualsGroup](#)
The optical residuals group allows exchange of orbital residuals, astrometric, photometric, or both.
- class [Software](#)
- class [Submitter](#)
- class [Telescope](#)

1.27 Umbrella2.Pipeline.ExtraIO.Ipef Namespace Reference

Classes

- class [IpefDetection](#)
Represents a single detection, roughly equivalent to an MPC observation.
- class [IpefDetectionData](#)
Represents an instance of the output of a Umbrella detection pipeline in inter-pipeline exchange format.
- class [IpefDispatchAttribute](#)
Represents a point of dispatch for extension-defined [Ipef](#) groups.
- class [IpefDispatchGroup](#)
Represents sets of user-extensible [Ipef](#) groups. This structure ensures the extension groups do not clash with the main definitions.
- class [IpefGroupRegistry](#)
List of [Ipef](#) extensions for dynamic dispatch.
- class [IpefImageInfo](#)
Metadata for a single reduced image. Work in progress.
- class [IpefReducedImageMetadata](#)
Provides metadata about images reduced, which may be used in downstream pipelines. Work in progress.
- class [IpefTracklet](#)
Represents a tracklet (a group of observations of the presumed same object).
- class [IpefXml](#)
Converts in-memory representations of [Ipef](#) to the disk format (XML).
- class [Stamp](#)
Represents an individual stamp produced by the pipeline.
- class [StampSet](#)
Represents a set of stamps of a certain kind. Examples would be mean, median, masked or not.
- class [TrackletStamps](#)
List of stamps associated with the tracklet.
- class [UmbrellaGroupAttribute](#)
Represent a set of data from Umbrella.

1.28 Umbrella2.Pipeline.ExtraIO.Vizier Namespace Reference

Classes

- class [CommonDefaults](#)
Common defaults for [VizieR](#) queries.
- interface [IVizierParser](#)
Common interface for [VizieR](#) parsers.
- class [QueryEngine](#)
Engine for querying [VizieR](#).
- struct [QueryParams](#)
Parameters for the [VizieR](#) query.
- struct [TsvParameters](#)
Parameters for the [VizieR](#) TSV parser.
- class [TsvParser](#)
Parser for the TSV output from [VizieR](#).
- class [VotableParser](#)

1.29 Umbrella2.Pipeline.Utils Namespace Reference

Classes

- class [AutoscheduleExtensions](#)
Provides shortcuts for common pipeline image mapping tasks.

1.30 Umbrella2.Plugins Namespace Reference

Classes

- interface [IPluggableElementLoader](#)
Represents an [Umbrella2](#) plugin holder element which can load plugin elements.
- class [LoadableTypes](#)
Holds references to [Umbrella2](#) plugin holder elements. On loading new types, informs plugin holders that new types are available.

1.31 Umbrella2.PropertyModel Namespace Reference

Namespaces

- namespace [CommonProperties](#)

Classes

- interface [IExtendable](#)
- interface [IExtensionProperty](#)
 - Used to denote a property that can be attached to an object.*
- class [InsufficientInformationException](#)
 - Thrown when not enough types are available to compute a given property.*
- interface [IObjectPropertyViewer](#)
 - Interface for components that allow the user to view and modify a certain object property.*
- interface [IObjectViewer](#)
 - Interface for components that allow the user to view and modify object properties.*
- interface [IPropertyCalculator](#)
 - Represents a method that can compute an extension property of a given object from its other properties.*
- class [PropertyDescriptionAttribute](#)
 - Attribute marks a user-visible property or field.*
- class [PropertyListAttribute](#)
 - Indicates a field is in fact a list of properties (of the original object).*

1.32 Umbrella2.PropertyModel.CommonProperties Namespace Reference

Classes

- class [ImageSet](#)
 - Represents a set of images of the same sky surface, each processed differently.*
- class [ImageSource](#)
 - Represents the [ImageSet](#) an image belongs to.*
- class [ObjectIdentity](#)
 - Contains information on the identity of the object observed (i.e. which celestial body it is).*
- class [ObjectPhotometry](#)
 - Photometry measurements on the object.*
- class [ObjectPoints](#)
 - The collection of points covered by an object.*
- class [ObjectSize](#)
 - Holds information on the size of the object.*
- class [PairingProperties](#)
 - Holds information relevant to object pairing.*
- struct [SourceEllipse](#)
 - Represents an elliptical fit of a source's pixels.*
- class [TrackletVelocityRegression](#)
 - Represents the correlation coefficient on the regression of tracklet velocity.*

Enumerations

- enum [DetectionAlgorithm](#) : uint { [Unknown](#) = 0 , [Blob](#) = 1 , [Trail](#) = 2 , [SourceExtractor](#) = 4 }
 - Detection algorithms used.*

1.32.1 Enumeration Type Documentation

DetectionAlgorithm

```
enum Umbrella2.PropertyModel.CommonProperties.DetectionAlgorithm : uint
```

Detection algorithms used.

Enumerator

Unknown	Unknown status.
Blob	Umbrella-builtin blob algorithm.
Trail	Umbrella-builtin long trails algorithm.
SourceExtractor	Imported from AstrOmatic Source Extractor.

1.33 Umbrella2.SharedBase Namespace Reference

Classes

- class [CartesianRay](#)
Represents a ray through the image stack, typically corresponding to a detection. Coordinates are in pixels of the image stack, starting an externally-defined reference point.
- class [ChartedRay](#)
A ray representing the motion of an object in the tangent space defined by the reference (gnomonic) projection at the time reference specified.

1.34 Umbrella2.Utils Namespace Reference

Classes

- class [ImplicitReflection](#)

1.35 Umbrella2.Visualizer Namespace Reference

Namespaces

- namespace [Winforms](#)

1.36 Umbrella2.Visualizer.Winforms Namespace Reference

Classes

- class [FitsView](#)
WinForms control to display a FITS image (or a portion of it).
- interface [IFitsViewScaler](#)
Represents an image scaling algorithm, for compressing the double precision floating point input to an 8-bit pixel value.
- class [LinearScaler](#)
Algorithm for scaling input images linearly.
- class [PropertyViewer](#)
Provides a mechanism for viewing all the IExtensionProperty attached to given objects.
- class [TrackletOutput](#)
Provides a visualization mechanism for tracklets.

1.37 Umbrella2.Visualizers Namespace Reference

Namespaces

- namespace [Winforms](#)

1.38 Umbrella2.Visualizers.Winforms Namespace Reference

Classes

- class [TrackletOutputUtils](#)

1.39 Umbrella2.WCS Namespace Reference

Namespaces

- namespace [Projections](#)

Classes

- class [EquatorialDistance](#)
Functions for computing distances on spherical coordinates.
- interface [IWCSProjection](#)
- class [ProjectionAttribute](#)
Attribute for recognizing [WCS](#) projection algorithms.
- class [WCSLinPart](#)
Computes linear the linear part of the [WCS](#) transforms.
- class [WCSProjectionTransform](#)
- class [WCSViaProjection](#)
Represents a transform of FITS image coordinates to [WCS](#) via a linear map and a spherical projection.

1.40 Umbrella2.WCS.Projections Namespace Reference

Classes

- class [TAN](#)
Gnomonic projection algorithm for image [WCS](#).
- class [WCSProjections](#)
Functions for dealing with [WCS](#) projection algorithms.

2 Class Documentation

2.1 Umbrella2.Pipeline.ExtraIO.Ades.AdesConverter Class Reference

Provides conversion functions from ADES to MPC.

Static Public Member Functions

- static void [AdesToEightyColumn](#) ([OpticalObservation](#) detection, System.IO.TextWriter mpcStream)
Converts a single ADES optical detection to MPC 80-column.
- static void [AdesToEightyColumn](#) ([AdesReport](#) report, System.IO.TextWriter mpcStream)
Generates an MPC 80-column report from an ADES report.
- static [OpticalObservation](#) [IpefToAdes](#) ([Ipef.IpefDetection](#) detection)
Converts a single IPEF detection to ADES.
- static [AdesReport](#) [IpefToAdes](#) ([Ipef.IpefDetectionData](#) detectionData)
Converts an IPEF detection dataset to an ADES report.

Static Private Member Functions

- static char [GetOptionalFirstChar](#) (string Input)

Static Private Attributes

- const double [Deg2Rad](#) = System.Math.PI / 180

2.1.1 Detailed Description

Provides conversion functions from ADES to MPC.

2.1.2 Member Function Documentation

AdesToEightyColumn() [1/2]

```
static void Umbrella2.Pipeline.ExtraIO.Ades.AdesConverter.AdesToEightyColumn (
    AdesReport report,
    System.IO.TextWriter mpcStream) [static]
```

Generates an MPC 80-column report from an ADES report.

Parameters

<i>report</i>	Input report.
<i>mpcStream</i>	Output System.IO.TextWriter for the MPC report.

AdesToEightyColumn() [2/2]

```
static void Umbrella2.Pipeline.ExtraIO.Ades.AdesConverter.AdesToEightyColumn (
    OpticalObservation detection,
    System.IO.TextWriter mpcStream) [static]
```

Converts a single ADES optical detection to MPC 80-column.

Parameters

<i>detection</i>	ADES detection to convert.
<i>mpcStream</i>	Output System.IO.TextWriter for the MPC report.

GetOptionalFirstChar()

```
static char Umbrella2.Pipeline.ExtraIO.Ades.AdesConverter.GetOptionalFirstChar (  
    string Input) [static], [private]
```

IpefToAdes() [1/2]

```
static OpticalObservation Umbrella2.Pipeline.ExtraIO.Ades.AdesConverter.IpefToAdes (  
    Ipef.IpefDetection detection) [static]
```

Converts a single IPEF detection to ADES.

Parameters

<i>detection</i>	Detection to convert.
------------------	-----------------------

Returns

Detection in ADES format (internal structure).

IpefToAdes() [2/2]

```
static AdesReport Umbrella2.Pipeline.ExtraIO.Ades.AdesConverter.IpefToAdes (  
    Ipef.IpefDetectionData detectionData) [static]
```

Converts an IPEF detection dataset to an ADES report.

Parameters

<i>detectionData</i>	Detection dataset to convert.
----------------------	-------------------------------

Returns

ADES report (internal structure).

2.1.3 Member Data Documentation**Deg2Rad**

```
const double Umbrella2.Pipeline.ExtraIO.Ades.AdesConverter.Deg2Rad = System.Math.PI / 180  
[static], [private]
```

2.2 Umbrella2.Pipeline.ExtraIO.Ades.AdesReport Class Reference

Represents a report (ADES data block), with an individual context and the associated observations.

Public Member Functions

- [AdesReport](#) ()

Public Attributes

- [ObservationContext](#) `Context`
Information on the instruments and authors of the report data.
- [OpticalObservation](#)[] `Observations`
List of observations (detections).

2.2.1 Detailed Description

Represents a report (ADES data block), with an individual context and the associated observations.

2.2.2 Constructor & Destructor Documentation

AdesReport()

```
Umbrella2.Pipeline.ExtraIO.Ades.AdesReport.AdesReport ()
```

2.2.3 Member Data Documentation

Context

```
ObservationContext Umbrella2.Pipeline.ExtraIO.Ades.AdesReport.Context
```

Information on the instruments and authors of the report data.

Observations

```
OpticalObservation [] Umbrella2.Pipeline.ExtraIO.Ades.AdesReport.Observations
```

List of observations (detections).

2.3 Umbrella2.Pipeline.ExtraIO.Ades.AdesVersion Class Reference

ADES document versions.

Static Public Attributes

- const string [Ver2017](#) = "2017"
- const string [Ver2022](#) = "2022"

2.3.1 Detailed Description

ADES document versions.

2.3.2 Member Data Documentation

Ver2017

```
const string Umbrella2.Pipeline.ExtraIO.Ades.AdesVersion.Ver2017 = "2017" [static]
```

Ver2022

```
const string Umbrella2.Pipeline.ExtraIO.Ades.AdesVersion.Ver2022 = "2022" [static]
```

2.4 Umbrella2.Pipeline.ExtraIO.Ades.AdesXml Class Reference

[Umbrella2](#) ADES representation conversion to and from XML.

Static Public Member Functions

- static XDocument [GenerateAdes](#) ([AdesReport](#) report)
Generates the XML corresponding to the input ADES report.
- static [AdesReport ReadAdes](#) (XDocument adesDocument)
Reads an ADES report from the input XML.

Static Private Member Functions

- static IEnumerable< XElement > [GetMatchingChildren](#) (XElement ancestor, string elementName, Type baseType)
Gets children that match the [EntryAttributeXmlAttributes](#) attached to the target group.
- static void [FillGroupWithXML](#) (Type rootType, object rootInstance, XElement ancestor)
Fills the [Umbrella2](#) ADES group representations from an XML document.
- static void [FillXmlWithGroup](#) (Type rootType, object rootInstance, XElement ancestor)
Fills the generated ADES XML with a group.

2.4.1 Detailed Description

[Umbrella2](#) ADES representation conversion to and from XML.

2.4.2 Member Function Documentation

FillGroupWithXML()

```
static void Umbrella2.Pipeline.ExtraIO.Ades.AdesXml.FillGroupWithXML (
    Type rootType,
    object rootInstance,
    XElement ancestor) [static], [private]
```

Fills the [Umbrella2](#) ADES group representations from an XML document.

Parameters

<i>rootType</i>	Type of the target root object.
<i>rootInstance</i>	The ADES structure to fill.
<i>ancestor</i>	XML element containing the group data.

FillXmlWithGroup()

```
static void Umbrella2.Pipeline.ExtraIO.Ades.AdesXml.FillXmlWithGroup (
    Type rootType,
    object rootInstance,
    XElement ancestor) [static], [private]
```

Fills the generated ADES XML with a group.

Parameters

<i>rootType</i>	Type of the root object.
<i>rootInstance</i>	Instance to be transformed to XML.
<i>ancestor</i>	Ancestor element for this group.

GenerateAdes()

```
static XDocument Umbrella2.Pipeline.ExtraIO.Ades.AdesXml.GenerateAdes (
    AdesReport report) [static]
```

Generates the XML corresponding to the input ADES report.

Parameters

<i>report</i>	Report to convert to XML.
---------------	---------------------------

Returns

An XML document with the ADES report.

GetMatchingChildren()

```
static IEnumerable< XElement > Umbrella2.Pipeline.ExtraIO.Ades.AdesXml.GetMatchingChildren (
    XElement ancestor,
    string elementName,
    Type baseType) [static], [private]
```

Gets children that match the [EntryAttributeXmlAttributes](#) attached to the target group.

Parameters

<i>ancestor</i>	XML element containing as children the XML elements in which to search.
<i>elementName</i>	Name of the XML element to find.
<i>baseType</i>	Group type. Used to discover the EntryAttributeXmlAttributes .

Returns

A list of XML elements matching the attributes of the group.

ReadAdes()

```
static AdesReport Umbrella2.Pipeline.ExtraIO.Ades.AdesXml.ReadAdes (
    XDocument adesDocument) [static]
```

Reads an ADES report from the input XML.

Parameters

<i>adesDocument</i>	XML document contating the ADES report.
---------------------	---

Returns

The ADES report converted to the internal structures.

2.5 Umbrella2.Algorithms.Images.RLHT.AlgorithmData Struct Reference

Bag of data containing runtime [RLHT](#) values.

Package Attributes

- bool [SimpleLine](#)
- double [StrongHoughThreshold](#)
- Func< double, double > [StrongValueFunction](#)
- int [ScanSkip](#)
- int [LineSkip](#)
- Misc.MTPool< double[,]> [HTPool](#)
- Misc.MTPool< List< Vector > > [VPool](#)

2.5.1 Detailed Description

Bag of data containing runtime [RLHT](#) values.

2.5.2 Member Data Documentation**HTPool**

```
Misc.MTPool<double[,]> Umbrella2.Algorithms.Images.RLHT.AlgorithmData.HTPool [package]
```

LineSkip

```
int Umbrella2.Algorithms.Images.RLHT.AlgorithmData.LineSkip [package]
```

ScanSkip

```
int Umbrella2.Algorithms.Images.RLHT.AlgorithmData.ScanSkip [package]
```

SimpleLine

```
bool Umbrella2.Algorithms.Images.RLHT.AlgorithmData.SimpleLine [package]
```

StrongHoughThreshold

```
double Umbrella2.Algorithms.Images.RLHT.AlgorithmData.StrongHoughThreshold [package]
```

StrongValueFunction

```
Func<double, double> Umbrella2.Algorithms.Images.RLHT.AlgorithmData.StrongValueFunction [package]
```

VPool

```
Misc.MTPool<List<Vector> > Umbrella2.Algorithms.Images.RLHT.AlgorithmData.VPool [package]
```

2.6 Umbrella2.Algorithms.Images.SchedCore.AlgorithmRunParameters Struct Reference

Common algorithm parameters. Usually specified by algorithm type.

Public Attributes

- int [InputMargins](#)
Amount of data to read around the current working window.
- int [Xstep](#)
Amount of X-coordinate data to be fed at once in the function. When set to 0, it is implicitly set to the image width.
- int [Ystep](#)
Amount of Y-coordinate data to be fed at once in the function.
- bool [FillZero](#)
Whether to ignore the image margins and fill regions outside the image with zeros. Must be set to true if [InputMargins](#) or [Xstep](#) is non-zero.

2.6.1 Detailed Description

Common algorithm parameters. Usually specified by algorithm type.

2.6.2 Member Data Documentation

FillZero

```
bool Umbrella2.Algorithms.Images.SchedCore.AlgorithmRunParameters.FillZero
```

Whether to ignore the image margins and fill regions outside the image with zeros. Must be set to true if [InputMargins](#) or [Xstep](#) is non-zero.

InputMargins

```
int Umbrella2.Algorithms.Images.SchedCore.AlgorithmRunParameters.InputMargins
```

Amount of data to read around the current working window.

Xstep

```
int Umbrella2.Algorithms.Images.SchedCore.AlgorithmRunParameters.Xstep
```

Amount of X-coordinate data to be fed at once in the function. When set to 0, it is implicitly set to the image width.

Ystep

```
int Umbrella2.Algorithms.Images.SchedCore.AlgorithmRunParameters.Ystep
```

Amount of Y-coordinate data to be fed at once in the function.

2.7 Umbrella2.Algorithms.Schedulers.AlgorithmRunParameters Struct Reference

Common algorithm parameters. Usually specified by algorithm type.

Public Attributes

- int [InputMargins](#)
Amount of data to read around the current working window. Defaults to 0.
- int [Xstep](#)
Amount of X-coordinate data to be fed at once in the function. When set to 0, it is implicitly set to the image width.
- int [Ystep](#)
Amount of Y-coordinate data to be fed at once in the function. If set to 0, the scheduler will choose the default size.
- bool [FillZero](#)
Whether to ignore the image margins and fill regions outside the image with zeros. Must be set to true if [InputMargins](#) or [Xstep](#) is non-zero.

2.7.1 Detailed Description

Common algorithm parameters. Usually specified by algorithm type.

2.7.2 Member Data Documentation

FillZero

```
bool Umbrella2.Algorithms.Schedulers.AlgorithmRunParameters.FillZero
```

Whether to ignore the image margins and fill regions outside the image with zeros. Must be set to true if [InputMargins](#) or [Xstep](#) is non-zero.

InputMargins

```
int Umbrella2.Algorithms.Schedulers.AlgorithmRunParameters.InputMargins
```

Amount of data to read around the current working window. Defaults to 0.

Xstep

```
int Umbrella2.Algorithms.Schedulers.AlgorithmRunParameters.Xstep
```

Amount of X-coordinate data to be fed at once in the function. When set to 0, it is implicitly set to the image width.

Ystep

```
int Umbrella2.Algorithms.Schedulers.AlgorithmRunParameters.Ystep
```

Amount of Y-coordinate data to be fed at once in the function. If set to 0, the scheduler will choose the default size.

2.8 Umbrella2.Algorithms.Detection.ApproxRecover Class Reference

Provides functions for recovering tracklets and detections on a (different) set of images.

Public Member Functions

- [ApproxRecover](#) ()
- bool [RecoverDetection](#) ([Position](#) DetPos, [Image](#) Img, double Radius, IEnumerable< [Image](#) > InputImages, out [ImageDetection](#) Recovered)
Attempts to recover a detection on a given image, comparing with the entire set of exposures.
- bool [RecoverTracklet](#) ([TrackletVelocityRegression](#) tvr, IEnumerable< [Image](#) > InputImages, out [Tracklet](#) Recovered)
Recovers the tracklet on a given set of images (typically pipeline input ones).

Public Attributes

- int `HalfLength` = 25
Detection window size.
- double `ThresholdMultiplier` = 1.5
Detection threshold in standard deviations.
- int `MinPix` = 7
Minimum number of pixels for a valid positive detection.
- double `MinMoveArcSec` = 0.2
Movement threshold over which the detection is not considered a fixed star.
- int `CrossMatchRemove`
Threshold number of detections on different images (noise and fixed star) after which the detection is considered bogus.
- double `NoisePixelThreshold` = 0.75
Threshold for the ratio of pixels over which the detection's noise counter is increased.
- double `StarFluxThreshold` = 0.6
Threshold for the ratio of fluxes over which the detection's fixed star counter is increased.
- double `RecoverRadius` = 30
Maximum radius of a recovered detection.
- int `MinDetections` = 3
Minimum number of detections for a valid recovered tracklet.

Private Member Functions

- `DotDetector.DotDetection Recover` (`PixelPoint` Location, double Radius, `Image` RecoveryImage)
Attempts to recover a detection on an image.
- bool `InDisk` (int X, int Y, double Radius)
Checks if the given point is within a given Radius of the center (`HalfLength`).

Static Private Member Functions

- static void `ComputeSmartStats` (double[,] Data, double Sigma1, out double Median, out double MedSigma)

2.8.1 Detailed Description

Provides functions for recovering tracklets and detections on a (different) set of images.

2.8.2 Constructor & Destructor Documentation

ApproxRecover()

```
Umbrella2.Algorithms.Detection.ApproxRecover.ApproxRecover ()
```

2.8.3 Member Function Documentation

ComputeSmartStats()

```
static void Umbrella2.Algorithms.Detection.ApproxRecover.ComputeSmartStats (
    double Data[],
    double Sigma1,
    out double Median,
    out double MedSigma) [static], [private]
```

InDisk()

```
bool Umbrella2.Algorithms.Detection.ApproxRecover.InDisk (
    int X,
    int Y,
    double Radius) [private]
```

Checks if the given point is within a given *Radius* of the center ([HalfLength](#)).

Recover()

```
DotDetector.DotDetection Umbrella2.Algorithms.Detection.ApproxRecover.Recover (
    PixelPoint Location,
    double Radius,
    Image RecoveryImage) [private]
```

Attempts to recover a detection on an image.

Returns

The recovered object.

Parameters

<i>Location</i>	Location which to check.
<i>Radius</i>	Maximum radius of the detection.
<i>RecoveryImage</i>	Image on which to perform the recovery.

RecoverDetection()

```
bool Umbrella2.Algorithms.Detection.ApproxRecover.RecoverDetection (
    Position DetPos,
    Image Img,
    double Radius,
    IEnumerable< Image > InputImages,
    out ImageDetection Recovered)
```

Attempts to recover a detection on a given image, comparing with the entire set of exposures.

Returns

true, if detection was recovered, false otherwise.

Parameters

<i>DetPos</i>	Position of the detection to recover.
<i>Img</i>	Image on which to recover.
<i>Radius</i>	Maximum radius of the detection.
<i>InputImages</i>	Input images.
<i>Recovered</i>	Recovered detection.

RecoverTracklet()

```
bool Umbrella2.Algorithms.Detection.ApproxRecover.RecoverTracklet (
    TrackletVelocityRegression tvr,
    IEnumerable< Image > InputImages,
    out Tracklet Recovered)
```

Recovers the tracklet on a given set of images (typically pipeline input ones).

Returns

true, if tracklet was recovered, false otherwise.

Parameters

<i>tvr</i>	TrackletVelocityRegression from which the positions are computed.
<i>InputImages</i>	Images on which to perform the recovery.
<i>Recovered</i>	Recovered tracklet.

2.8.4 Member Data Documentation**CrossMatchRemove**

```
int Umbrella2.Algorithms.Detection.ApproxRecover.CrossMatchRemove
```

Threshold number of detections on different images (noise and fixed star) after which the detection is considered bogus.

HalfLength

```
int Umbrella2.Algorithms.Detection.ApproxRecover.HalfLength = 25
```

Detection window size.

MinDetections

```
int Umbrella2.Algorithms.Detection.ApproxRecover.MinDetections = 3
```

Minimum number of detections for a valid recovered tracklet.

MinMoveArcSec

```
double Umbrella2.Algorithms.Detection.ApproxRecover.MinMoveArcSec = 0.2
```

Movement threshold over which the detection is not considered a fixed star.

MinPix

```
int Umbrella2.Algorithms.Detection.ApproxRecover.MinPix = 7
```

Minimum number of pixels for a valid positive detection.

NoisePixelThreshold

```
double Umbrella2.Algorithms.Detection.ApproxRecover.NoisePixelThreshold = 0.75
```

Threshold for the ratio of pixels over which the detection's noise counter is increased.

RecoverRadius

```
double Umbrella2.Algorithms.Detection.ApproxRecover.RecoverRadius = 30
```

Maximum radius of a recovered detection.

StarFluxThreshold

```
double Umbrella2.Algorithms.Detection.ApproxRecover.StarFluxThreshold = 0.6
```

Threshold for the ratio of fluxes over which the detection's fixed star counter is increased.

ThresholdMultiplier

```
double Umbrella2.Algorithms.Detection.ApproxRecover.ThresholdMultiplier = 1.5
```

[Detection](#) threshold in standard deviations.

2.9 Umbrella2.Pipeline.Utils.AutoscheduleExtensions Class Reference

Provides shortcuts for common pipeline image mapping tasks.

Static Public Member Functions

- static `Image EnsureImage` (Action< `Image` > Algorithm, `Image` Model, string OutputName, int BitPix=0, List< `ImageProperties` > ExtraProperties=null)
Ensures that a certain image is present.
- static `Image EnsureImage` (Action< `Image` > Algorithm, `Image` Model, string RunDir, string Name, int Number, int BitPix=0, List< `ImageProperties` > ExtraProperties=null)
Ensures that a certain image is present.
- static `Image EnsureImage` (Action< `Image` > Algorithm, `Image` Input, string RunDir, string Name, int Number, string DisplayName, int BitPix=0, List< `ImageProperties` > ExtraProperties=null)
Ensures that a certain image is present.
- static `Image SchedEnsure< T >` (SchedCore.SimpleMap< T > Algorithm, SchedCore.AlgorithmRunParameters Parameters, T Argument, `Image` Input, string RunDir, string Name, int Number, int BitPix=0, List< `ImageProperties` > ExtraProperties=null)
Ensures that a certain image is present.
- static `Image SchedEnsure< T >` (SchedCore.PositionDependentMap< T > Algorithm, SchedCore.AlgorithmRunParameters Parameters, T Argument, `Image` Input, string RunDir, string Name, int Number, int BitPix=0, List< `ImageProperties` > ExtraProperties=null)
Ensures that a certain image is present.
- static `Image SchedEnsure< T >` (SchedCore.SimpleMap< T > Algorithm, SchedCore.AlgorithmRunParameters Parameters, T Argument, `Image` Input, string RunDir, string Name, int Number, string DisplayName, int BitPix=0, List< `ImageProperties` > ExtraProperties=null)
Ensures that a certain image is present.
- static `Image SchedEnsure< T >` (SchedCore.PositionDependentMap< T > Algorithm, SchedCore.AlgorithmRunParameters Parameters, T Argument, `Image` Input, string RunDir, string Name, int Number, string DisplayName, int BitPix=0, List< `ImageProperties` > ExtraProperties=null)
Ensures that a certain image is present.

Static Public Attributes

- static int `DefaultBitPix` = -32
Default BITPIX value for output images.

2.9.1 Detailed Description

Provides shortcuts for common pipeline image mapping tasks.

2.9.2 Member Function Documentation

EnsureImage() [1/3]

```
static Image Umbrella2.Pipeline.Utils.AutoscheduleExtensions.EnsureImage (
    Action< Image > Algorithm,
    Image Input,
    string RunDir,
    string Name,
    int Number,
    string DisplayName,
    int BitPix = 0,
    List< ImageProperties > ExtraProperties = null) [static]
```

Ensures that a certain image is present.

Parameters

<i>Algorithm</i>	Algorithm to generate the image if it is not present.
<i>Input</i>	Image assumed to be the input of the algorithm.
<i>RunDir</i>	Working directory of the pipeline.
<i>Name</i>	Name of the output file.
<i>Number</i>	Output file's sequence number.
<i>DisplayName</i>	Name as added to the ImageSource list.
<i>BitPix</i>	BITPIX value of the output image.
<i>ExtraProperties</i>	List of properties to be passed to the image constructor.

Returns

The desired image.

EnsureImage() [2/3]

```
static Image Umbrella2.Pipeline.Utils.AutoscheduleExtensions.EnsureImage (
    Action< Image > Algorithm,
    Image Model,
    string OutputName,
    int BitPix = 0,
    List< ImageProperties > ExtraProperties = null) [static]
```

Ensures that a certain image is present.

Parameters

<i>Algorithm</i>	Algorithm to generate the image if it is not present.
<i>Model</i>	Image to copy width, height and transform from.
<i>OutputName</i>	Path of the output image.
<i>BitPix</i>	BITPIX value of the output image.
<i>ExtraProperties</i>	List of properties to be passed to the image constructor.

Returns

The desired image.

EnsureImage() [3/3]

```
static Image Umbrella2.Pipeline.Utils.AutoscheduleExtensions.EnsureImage (
    Action< Image > Algorithm,
    Image Model,
    string RunDir,
    string Name,
    int Number,
    int BitPix = 0,
    List< ImageProperties > ExtraProperties = null) [static]
```

Ensures that a certain image is present.

Parameters

<i>Algorithm</i>	Algorithm to generate the image if it is not present.
<i>Model</i>	Image to copy width, height and transform from.
<i>RunDir</i>	Working directory of the pipeline.
<i>Name</i>	Name of the output file.
<i>Number</i>	Output file's sequence number.
<i>BitPix</i>	BITPIX value of the output image.
<i>ExtraProperties</i>	List of properties to be passed to the image constructor.

Returns

The desired image.

SchedEnsure< T >() [1/4]

```
static Image Umbrella2.Pipeline.Utils.AutoscheduleExtensions.SchedEnsure< T > (
    SchedCore.PositionDependentMap< T > Algorithm,
    SchedCore.AlgorithmRunParameters Parameters,
    T Argument,
    Image Input,
    string RunDir,
    string Name,
    int Number,
    int BitPix = 0,
    List< ImageProperties > ExtraProperties = null) [static]
```

Ensures that a certain image is present.

Parameters

<i>Algorithm</i>	Algorithm to generate the image if it is not present.
<i>Parameters</i>	Scheduler arguments for the algorithm.
<i>Argument</i>	Argument to be passed to the algorithm.
<i>Input</i>	Input image to the algorithm.
<i>RunDir</i>	Working directory of the pipeline.
<i>Name</i>	Name of the output file.
<i>Number</i>	Output file's sequence number.
<i>BitPix</i>	BITPIX value of the output image.
<i>ExtraProperties</i>	List of properties to be passed to the image constructor.

Returns

The desired image.

SchedEnsure< T >() [2/4]

```
static Image Umbrella2.Pipeline.Utils.AutoscheduleExtensions.SchedEnsure< T > (
    SchedCore.PositionDependentMap< T > Algorithm,
    SchedCore.AlgorithmRunParameters Parameters,
    T Argument,
    Image Input,
    string RunDir,
    string Name,
    int Number,
    string DisplayName,
    int BitPix = 0,
    List< ImageProperties > ExtraProperties = null) [static]
```

Ensures that a certain image is present.

Parameters

<i>Algorithm</i>	Algorithm to generate the image if it is not present.
<i>Parameters</i>	Scheduler arguments for the algorithm.
<i>Argument</i>	Argument to be passed to the algorithm.
<i>Input</i>	Input image to the algorithm.
<i>RunDir</i>	Working directory of the pipeline.
<i>Name</i>	Name of the output file.
<i>Number</i>	Output file's sequence number.
<i>DisplayName</i>	Name as added to the ImageSource list.
<i>BitPix</i>	BITPIX value of the output image.
<i>ExtraProperties</i>	List of properties to be passed to the image constructor.

Returns

The desired image.

SchedEnsure< T >() [3/4]

```
static Image Umbrella2.Pipeline.Utils.AutoscheduleExtensions.SchedEnsure< T > (
    SchedCore.SimpleMap< T > Algorithm,
    SchedCore.AlgorithmRunParameters Parameters,
    T Argument,
    Image Input,
    string RunDir,
    string Name,
    int Number,
    int BitPix = 0,
    List< ImageProperties > ExtraProperties = null) [static]
```

Ensures that a certain image is present.

Parameters

<i>Algorithm</i>	Algorithm to generate the image if it is not present.
<i>Parameters</i>	Scheduler arguments for the algorithm.

Parameters

<i>Argument</i>	Argument to be passed to the algorithm.
<i>Input</i>	Input image to the algorithm.
<i>RunDir</i>	Working directory of the pipeline.
<i>Name</i>	Name of the output file.
<i>Number</i>	Output file's sequence number.
<i>BitPix</i>	BITPIX value of the output image.
<i>ExtraProperties</i>	List of properties to be passed to the image constructor.

Returns

The desired image.

SchedEnsure< T >() [4/4]

```
static Image Umbrella2.Pipeline.Utils.AutoscheduleExtensions.SchedEnsure< T > (
    SchedCore.SimpleMap< T > Algorithm,
    SchedCore.AlgorithmRunParameters Parameters,
    T Argument,
    Image Input,
    string RunDir,
    string Name,
    int Number,
    string DisplayName,
    int BitPix = 0,
    List< ImageProperties > ExtraProperties = null) [static]
```

Ensures that a certain image is present.

Parameters

<i>Algorithm</i>	Algorithm to generate the image if it is not present.
<i>Parameters</i>	Scheduler arguments for the algorithm.
<i>Argument</i>	Argument to be passed to the algorithm.
<i>Input</i>	Input image to the algorithm.
<i>RunDir</i>	Working directory of the pipeline.
<i>Name</i>	Name of the output file.
<i>Number</i>	Output file's sequence number.
<i>DisplayName</i>	Name as added to the ImageSource list.
<i>BitPix</i>	BITPIX value of the output image.
<i>ExtraProperties</i>	List of properties to be passed to the image constructor.

Returns

The desired image.

2.9.3 Member Data Documentation

DefaultBitPix

```
int Umbrella2.Pipeline.Utils.AutoscheduleExtensions.DefaultBitPix = -32 [static]
```

Default BITPIX value for output images.

2.10 Umbrella2.Algorithms.Images.BadpixelFilter Class Reference

Support for badpixel removal. Currently removes badpixels by masking.

Static Public Member Functions

- static BitArray[] [CreateFilter](#) (Image BadpixelFile)
Creates a new BadPixel filter from a badpixel image.

Static Public Attributes

- static AlgorithmRunParameters [Parameters](#)
ParallelAlgorithm options.
- static PositionDependentMap< BitArray[]> [Filter](#) = [MaskBadpixel](#)
Badpixel filter function.

Static Private Member Functions

- static void [DetectSources](#) (double[,] Input, ImageSegmentPosition [Position](#), BitArray[] Mask)
- static void [MaskBadpixel](#) (double[,] Input, double[,] Output, ImageSegmentPosition InputPosition, Image↔ SegmentPosition OutputPosition, BitArray[] Mask)

2.10.1 Detailed Description

Support for badpixel removal. Currently removes badpixels by masking.

2.10.2 Member Function Documentation

CreateFilter()

```
static BitArray[] Umbrella2.Algorithms.Images.BadpixelFilter.CreateFilter (
    Image BadpixelFile) [static]
```

Creates a new BadPixel filter from a badpixel image.

Parameters

<i>BadpixelFile</i>	Badpixel input image: masked pixels are non-zero.
---------------------	---

DetectSources()

```
static void Umbrella2.Algorithms.Images.BadpixelFilter.DetectSources (
    double Input[],
    ImageSegmentPosition Position,
    BitArray[] Mask) [static], [private]
```

MaskBadpixel()

```
static void Umbrella2.Algorithms.Images.BadpixelFilter.MaskBadpixel (
    double Input[],
    double Output[],
    ImageSegmentPosition InputPosition,
    ImageSegmentPosition OutputPosition,
    BitArray[] Mask) [static], [private]
```

2.10.3 Member Data Documentation

Filter

```
PositionDependentMap<BitArray[]> Umbrella2.Algorithms.Images.BadpixelFilter.Filter = MaskBadpixel
[static]
```

Badpixel filter function.

Parameters

```
AlgorithmRunParameters Umbrella2.Algorithms.Images.BadpixelFilter.Parameters [static]
```

Initial value:

```
= new AlgorithmRunParameters()
{
    FillZero = false,
    InputMargins = 0,
    Xstep = 0,
    Ystep = 50
}
```

ParallelAlgorithm options.

2.11 Umbrella2.Algorithms.Filtering.BadzoneFilter Class Reference

Filters detections in bad image areas.

Classes

- struct [ConvexPolygon](#)
- struct [Vector](#)

Public Member Functions

- [BadzoneFilter](#) (List< List< [PixelPoint](#) > > Badzones)
Creates a new instance using the given points as vertices of convex polygons.
- bool [Filter](#) ([ImageDetection](#) Input)

Private Attributes

- List< [ConvexPolygon](#) > [BadAreas](#)
Bad areas on the input images.

2.11.1 Detailed Description

Filters detections in bad image areas.

2.11.2 Constructor & Destructor Documentation

BadzoneFilter()

```
Umbrella2.Algorithms.Filtering.BadzoneFilter.BadzoneFilter (
    List< List< PixelPoint > > Badzones)
```

Creates a new instance using the given points as vertices of convex polygons.

Parameters

<i>Badzones</i>	A list of convex polygons in the form of lists of vertices.
-----------------	---

2.11.3 Member Function Documentation

Filter()

```
bool Umbrella2.Algorithms.Filtering.BadzoneFilter.Filter (
    ImageDetection Input)
```

Implements [Umbrella2.Algorithms.Filtering.IImageDetectionFilter](#).

2.11.4 Member Data Documentation

BadAreas

```
List<ConvexPolygon> Umbrella2.Algorithms.Filtering.BadzoneFilter.BadAreas [private]
```

Bad areas on the input images.

2.12 Umbrella2.Algorithms.Images.BasicImstatSolver Class Reference

Simple solver for producing [ImageStatistics](#).

Static Public Member Functions

- static void [BasicSolver](#) ([Image Image](#), out double *ZeroLevel*, out double *StDev*)
Solver function conforming to [ImageStatistics.StatisticsSolver](#).

Static Private Member Functions

- static void [RunStatistics](#) (double[,] *Input*, [BasicImstatSolver Stats](#))
Computation function.

Private Attributes

- List< double > [Means](#)
- List< double > [Variances](#)

Static Private Attributes

- static [SchedCore.Extractor](#)< [BasicImstatSolver](#) > [StatAlgorithm](#) = [RunStatistics](#)
Accessible form of the computation function.

2.12.1 Detailed Description

Simple solver for producing [ImageStatistics](#).

2.12.2 Member Function Documentation

BasicSolver()

```
static void Umbrella2.Algorithms.Images.BasicImstatSolver.BasicSolver (
    Image Image,
    out double ZeroLevel,
    out double StDev) [static]
```

Solver function conforming to [ImageStatistics.StatisticsSolver](#).

RunStatistics()

```
static void Umbrella2.Algorithms.Images.BasicImstatSolver.RunStatistics (
    double Input[],
    BasicImstatSolver Stats) [static], [private]
```

Computation function.

Parameters

<i>Input</i>	Input data.
<i>Stats</i>	Result collector.

2.12.3 Member Data Documentation

Means

List<double> Umbrella2.Algorithms.Images.BasicImstatSolver.Means [private]

StatAlgorithm

SchedCore.Extractor<BasicImstatSolver> Umbrella2.Algorithms.Images.BasicImstatSolver.StatAlgorithm = RunStatistics [static], [private]

Accessible form of the computation function.

Variances

List<double> Umbrella2.Algorithms.Images.BasicImstatSolver.Variances [private]

2.13 Umbrella2.Algorithms.Filtering.BrightnessThicknessFilter Class Reference

Filters out sources which are too bright for their thickness. Used mainly for preventing white bands from being interpreted as sources.

Public Member Functions

- bool [Filter](#) ([ImageDetection](#) Input)

Static Public Member Functions

- static implicit operator [Predicate](#)< [ImageDetection](#) > ([BrightnessThicknessFilter](#) f)

Public Attributes

- double [BrightnessThreshold](#)
Brightness threshold in image flux.
- double [ThicknessThreshold](#)
Thickness threshold in pixels.

2.13.1 Detailed Description

Filters out sources which are too bright for their thickness. Used mainly for preventing white bands from being interpreted as sources.

2.13.2 Member Function Documentation

Filter()

```
bool Umbrella2.Algorithms.Filtering.BrightnessThicknessFilter.Filter (
    ImageDetection Input)
```

Implements [Umbrella2.Algorithms.Filtering.IImageDetectionFilter](#).

operator Predicate< ImageDetection >()

```
static implicit Umbrella2.Algorithms.Filtering.BrightnessThicknessFilter.operator Predicate<
ImageDetection > (
    BrightnessThicknessFilter f) [static]
```

2.13.3 Member Data Documentation

BrightnessThreshold

```
double Umbrella2.Algorithms.Filtering.BrightnessThicknessFilter.BrightnessThreshold
```

Brightness threshold in image flux.

ThicknessThreshold

```
double Umbrella2.Algorithms.Filtering.BrightnessThicknessFilter.ThicknessThreshold
```

Thickness threshold in pixels.

2.14 ImagingToolkit.ImageIO.ByteBitmap Class Reference

Bitmap with a byte backend; based on Windows Bitmaps.

Public Member Functions

- [ByteBitmap](#) (int [Width](#), int [Height](#))
Creates a new [ByteBitmap](#) with a specified width and height.
- [ByteBitmap](#) (Bitmap b)
Creates a new [ByteBitmap](#) from an existing Windows Bitmap.
- Bitmap [GetWindowsBitmap](#) ()
Gets a Windows Bitmap from the current [ByteBitmap](#).

Public Attributes

- readonly int [Width](#)
- readonly int [Height](#)
- byte[,] [Data](#)

Color data. Indices: y, x, channel.

2.14.1 Detailed Description

Bitmap with a byte backend; based on Windows Bitmaps.

2.14.2 Constructor & Destructor Documentation

ByteBitmap() [1/2]

```
ImagingToolkit.ImageIO.ByteBitmap.ByteBitmap (  
    int Width,  
    int Height)
```

Creates a new [ByteBitmap](#) with a specified width and height.

ByteBitmap() [2/2]

```
ImagingToolkit.ImageIO.ByteBitmap.ByteBitmap (  
    Bitmap b)
```

Creates a new [ByteBitmap](#) from an existing Windows Bitmap.

2.14.3 Member Function Documentation

GetWindowsBitmap()

```
Bitmap ImagingToolkit.ImageIO.ByteBitmap.GetWindowsBitmap ()
```

Gets a Windows Bitmap from the current [ByteBitmap](#).

2.14.4 Member Data Documentation

Data

```
byte [,] ImagingToolkit.ImageIO.ByteBitmap.Data
```

Color data. Indices: y, x, channel.

Height

```
readonly int ImagingToolkit.ImageIO.ByteBitmap.Height
```

Width

```
readonly int ImagingToolkit.ImageIO.ByteBitmap.Width
```

2.15 Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs Struct Reference

Parameters of the calibration algorithm.

Public Attributes

- double [PositionError](#)
Maximum distance between a star on VizieR and another on the image that are paired (in arcseconds).
- double [StarHighThreshold](#)
Value for [DotDetector.HighThresholdMultiplier](#) when detecting stars.
- double [StarLowThreshold](#)
Value for [DotDetector.LowThresholdMultiplier](#) when detecting stars.
- double [NonRepThreshold](#)
Value for [DotDetector.NonrepresentativeThreshold](#) when detecting stars.
- double [MinFlux](#)
Minimum flux for stars used in calibration.
- double [MaxFlux](#)
Maximum flux for stars used in calibration.
- double [ClippingPoint](#)
Maximum intensity for each pixel for stars used in calibration.
- double [MaxVizierMag](#)
Maximum magnitude of objects from VizieR used in calibration.
- double [ObjectApertureMultiplier](#)
- double [ObjectApertureExpansion](#)
- double [SurroundApertureMultiplier](#)
- double [SurroundApertureExpansion](#)

2.15.1 Detailed Description

Parameters of the calibration algorithm.

2.15.2 Member Data Documentation

ClippingPoint

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs.ClippingPoint
```

Maximum intensity for each pixel for stars used in calibration.

MaxFlux

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs.MaxFlux
```

Maximum flux for stars used in calibration.

MaxVizierMag

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs.MaxVizierMag
```

Maximum magnitude of objects from VizieR used in calibration.

MinFlux

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs.MinFlux
```

Minimum flux for stars used in calibration.

NonRepThreshold

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs.NonRepThreshold
```

Value for [DotDetector.NonrepresentativeThreshold](#) when detecting stars.

ObjectApertureExpansion

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs.ObjectAperture↔  
Expansion
```

ObjectApertureMultiplier

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs.ObjectAperture↔  
Multiplier
```

PositionError

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs.PositionError
```

Maximum distance between a star on VizieR and another on the image that are paired (in arcseconds).

StarHighThreshold

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs.StarHighThreshold
```

Value for [DotDetector.HighThresholdMultiplier](#) when detecting stars.

StarLowThreshold

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs.StarLowThreshold
```

Value for [DotDetector.LowThresholdMultiplier](#) when detecting stars.

SurroundApertureExpansion

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs.SurroundAperture↔  
Expansion
```

SurroundApertureMultiplier

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrationArgs.SurroundAperture↔  
Multiplier
```

2.16 Umbrella2.SharedBase.CartesianRay Class Reference

Represents a ray through the image stack, typically corresponding to a detection. Coordinates are in pixels of the image stack, starting an externally-defined reference point.

Public Member Functions

- [CartesianRay](#) (float X, float Y, float [VX](#), float [VY](#))
Instantiates the ray using the reference position and the velocity.
- override string [ToString](#) ()
- [PixelPoint PositionAt](#) (float Time)
Returns the position of the ray at a given time (intersection with an isochronous image plane).

Public Attributes

- readonly double [SX](#)
X coordinate at reference time.
- readonly double [SY](#)
Y coordinate at reference time.
- readonly double [VX](#)
Velocity on the X coordinate in the image stack.
- readonly double [VY](#)
Velocity on the Y coordinate in the image stack.

Private Member Functions

- string [DtS](#) (double V)
Double to string.

Static Private Attributes

- const string `TSFmt` = "@({0}, {1})+\${{2}, {3}}"
Format string for the output.

2.16.1 Detailed Description

Represents a ray through the image stack, typically corresponding to a detection. Coordinates are in pixels of the image stack, starting an externally-defined reference point.

2.16.2 Constructor & Destructor Documentation

CarthesianRay()

```
Umbrella2.SharedBase.CarthesianRay.CarthesianRay (
    float X,
    float Y,
    float VX,
    float VY)
```

Instantiates the ray using the reference position and the velocity.

Parameters

<code>X</code>	Reference X coordinate.
<code>Y</code>	Reference Y coordinate.
<code>VX</code>	Velocity on the X axis.
<code>VY</code>	Velocity on the Y axis.

2.16.3 Member Function Documentation

DtS()

```
string Umbrella2.SharedBase.CarthesianRay.DtS (
    double V) [private]
```

Double to string.

PositionAt()

```
PixelPoint Umbrella2.SharedBase.CarthesianRay.PositionAt (
    float Time)
```

Returns the position of the ray at a given time (intersection with an isochronous image plane).

Returns

The position of the ray at the given time.

Parameters

<i>Time</i>	Time at which the position is requested.
-------------	--

ToString()

```
override string Umbrella2.SharedBase.CartesianRay.ToString ()
```

2.16.4 Member Data Documentation**SX**

```
readonly double Umbrella2.SharedBase.CartesianRay.SX
```

X coordinate at reference time.

SY

```
readonly double Umbrella2.SharedBase.CartesianRay.SY
```

Y coordinate at reference time.

TSFmt

```
const string Umbrella2.SharedBase.CartesianRay.TSFmt = "@({0}, {1})+${{2}, {3}}" [static],  
[private]
```

Format string for the output.

VX

```
readonly double Umbrella2.SharedBase.CartesianRay.VX
```

Velocity on the X coordinate in the image stack.

VY

```
readonly double Umbrella2.SharedBase.CartesianRay.VY
```

Velocity on the Y coordinate in the image stack.

2.17 Umbrella2.SharedBase.ChartedRay Class Reference

A ray representing the motion of an object in the tangent space defined by the reference (gnomonic) projection at the time reference specified.

Public Member Functions

- [ChartedRay](#) ([CarthesianRay](#) ray, [IWCSProjection](#) referenceTransform, [DateTime](#) referenceTime)
Instantiates a new [ChartedRay](#) using a motion vector and the space-time reference.
- override string [ToString](#) ()

Public Attributes

- readonly [CarthesianRay](#) Ray
Motion ray in the tangent plane.
- readonly [IWCSProjection](#) RefTransform
The chart mapping the motion ray to equatorial coordinates.
- readonly [DateTime](#) RefTime
Time reference, i.e. at which the object is at the start position.

2.17.1 Detailed Description

A ray representing the motion of an object in the tangent space defined by the reference (gnomonic) projection at the time reference specified.

2.17.2 Constructor & Destructor Documentation

ChartedRay()

```
Umbrella2.SharedBase.ChartedRay.ChartedRay (
    CarthesianRay ray,
    IWCSProjection referenceTransform,
    DateTime referenceTime)
```

Instantiates a new [ChartedRay](#) using a motion vector and the space-time reference.

Parameters

<i>ray</i>	Motion vector.
<i>referenceTransform</i>	Space reference.
<i>referenceTime</i>	Time reference.

2.17.3 Member Function Documentation

ToString()

```
override string Umbrella2.SharedBase.ChartedRay.ToString ()
```

2.17.4 Member Data Documentation

Ray

readonly [CarthesianRay](#) Umbrella2.SharedBase.ChartedRay.Ray

Motion ray in the tangent plane.

RefTime

readonly [DateTime](#) Umbrella2.SharedBase.ChartedRay.RefTime

Time reference, i.e. at which the object is at the start position.

RefTransform

readonly [IWCSProjection](#) Umbrella2.SharedBase.ChartedRay.RefTransform

The chart mapping the motion ray to equatorial coordinates.

2.18 Umbrella2.Pipeline.ExtraIO.Ades.Coinvestigators Class Reference

Public Attributes

- [string\[\] Name](#)
Names of coinvestigators (initials then surname), one individual per array element.

2.18.1 Member Data Documentation

Name

`string [] Umbrella2.Pipeline.ExtraIO.Ades.Coinvestigators.Name`

Names of coinvestigators (initials then surname), one individual per array element.

2.19 Umbrella2.Pipeline.ExtraIO.Ades.Collaborators Class Reference

Public Attributes

- [string\[\] Name](#)
Names of collaborators (initials then surname), one individual per array element.

2.19.1 Member Data Documentation

Name

```
string [] Umbrella2.Pipeline.ExtraIO.Ades.Collaborators.Name
```

Names of collaborators (initials then surname), one individual per array element.

2.20 Umbrella2.Pipeline.ExtraIO.Ades.Comment Class Reference

Public Attributes

- [string\[\] Line](#)
Explanatory remarks. Multiple line elements can be included and order is to be preserved.

2.20.1 Member Data Documentation

Line

```
string [] Umbrella2.Pipeline.ExtraIO.Ades.Comment.Line
```

Explanatory remarks. Multiple line elements can be included and order is to be preserved.

2.21 Umbrella2.Pipeline.ExtraIO.VizieR.CommonDefaults Class Reference

Common defaults for [VizieR](#) queries.

Public Types

- enum [CatalogShorthand](#) {
[GaiaDR3](#) , [GSC2020](#) , [PS1](#) , [Tess82](#) ,
[SDSS16](#) , [GaiaDR1](#) , [NOMAD](#) , [USNOB1](#) ,
[PPMXL](#) }
Shorthands for the common star catalogs.
- enum [ServerShorthand](#) {
[CDSGermany](#) , [CDSOld](#) , [ADACJapan](#) , [IUCAAIndia](#) ,
[INASANRussia](#) , [NAOCChina](#) , [HarvardUSA](#) , [IDIASouthAfrica](#) ,
[CambridgeUKOld](#) }
List of shorthands for available [VizieR](#) servers. May not be up to date.

Static Public Member Functions

- static string [MapKnownCatalogs](#) (string CatalogName)
Maps the known catalogs to their [VizieR](#) IDs. If no catalog is known by that name, the value is returned as-is.
- static string [MapKnownServer](#) (string ServerName)
Maps the known servers to their base URLs. If no server is known by that name, the value is returned as-is.

Static Public Attributes

- static readonly Dictionary< [CatalogShorthand](#), string > [CatalogMap](#)
Mapping of shorthands for common, large star catalogs to their [VizieR](#) names.
- static Dictionary< string, [CatalogShorthand](#) > [CatalogShortMap](#) = GenerateEnumMap<[CatalogShorthand](#)>()
Map of shorthand strings to their enum value.
- static readonly Dictionary< [ServerShorthand](#), string > [ServerMap](#)
Mapping of [VizieR](#) server shorthands to their base URLs. May not be up to date.
- static readonly Dictionary< string, [ServerShorthand](#) > [ServerShortMap](#) = GenerateEnumMap<[ServerShorthand](#)>()
Map of shorthand strings to their enum value.
- static readonly string [RadialSortOrder](#) = "_r"
Sort stars by radial distance from the center of the search area.
- static readonly string [J2kEquinox](#) = "J2000"
J2000 equinox value.
- static readonly [QueryParams DefaultQueryParameters](#)
Example query parameters.

2.21.1 Detailed Description

Common defaults for [VizieR](#) queries.

2.21.2 Member Enumeration Documentation

CatalogShorthand

enum [Umbrella2.Pipeline.ExtraIO.Vizier.CommonDefaults.CatalogShorthand](#)

Shorthands for the common star catalogs.

Enumerator

GaiaDR3	
GSC2020	
PS1	
Tess82	
SDSS16	
GaiaDR1	
NOMAD	
USNOB1	
PPMXL	

ServerShorthand

enum [Umbrella2.Pipeline.ExtraIO.Vizier.CommonDefaults.ServerShorthand](#)

List of shorthands for available [VizieR](#) servers. May not be up to date.

Enumerator

CDSGermany	
CDSOld	
ADACJapan	
IUCAAIndia	
INASANRussia	
NAOCChina	
HarvardUSA	
IDIASouthAfrica	
CambridgeUKOld	

2.21.3 Member Function Documentation

MapKnownCatalogs()

```
static string Umbrella2.Pipeline.ExtraIO.VizieR.CommonDefaults.MapKnownCatalogs (
    string CatalogName) [static]
```

Maps the known catalogs to their [VizieR](#) IDs. If no catalog is known by that name, the value is returned as-is.

Returns

The ID of the known catalog or the value as-is.

Parameters

<i>CatalogName</i>	Catalog name or its ID.
--------------------	-------------------------

MapKnownServer()

```
static string Umbrella2.Pipeline.ExtraIO.VizieR.CommonDefaults.MapKnownServer (
    string ServerName) [static]
```

Maps the known servers to their base URLs. If no server is known by that name, the value is returned as-is.

Returns

The base URL of the known server or the value as-is.

Parameters

<i>ServerName</i>	Server name or its base URL.
-------------------	------------------------------

2.21.4 Member Data Documentation

CatalogMap

readonly Dictionary<CatalogShorthand, string> Umbrella2.Pipeline.ExtraIO.Vizier.CommonDefaults.CatalogMap [static]

Initial value:

```
= new Dictionary<CatalogShorthand, string>()
{
    [CatalogShorthand.GaiaDR3] = "I/355/out",
    [CatalogShorthand.GSC2020] = "I/353/out",
    [CatalogShorthand.PS1] = "II/349/out",
    [CatalogShorthand.Tess82] = "IV/39/out",
    [CatalogShorthand.SDSS16] = "V/154/out",
    [CatalogShorthand.GaiaDR1] = "I/337/out",
    [CatalogShorthand.NOMAD] = "I/297/out",
    [CatalogShorthand.USNOB1] = "I/284/out",
    [CatalogShorthand.PPMXL] = "I/317/out",
}
```

Mapping of shorthands for common, large star catalogs to their [VizieR](#) names.

CatalogShortMap

Dictionary<string, CatalogShorthand> Umbrella2.Pipeline.ExtraIO.Vizier.CommonDefaults.CatalogShortMap = GenerateEnumMap<CatalogShorthand>() [static]

Map of shorthand strings to their enum value.

DefaultQueryParameters

readonly QueryParams Umbrella2.Pipeline.ExtraIO.Vizier.CommonDefaults.DefaultQueryParameters [static]

Initial value:

```
= new QueryParams()
{
    BaseUrl = nameof(ServerShorthand.CDSGermany),
    Catalog = nameof(CatalogShorthand.USNOB1),
    Equinox = J2kEquinox,
    Increasing = true,
    Order = RadialSortOrder,
    Parser = new TsvParser(new TsvParameters() { ExpectedFieldCount = 14, RaPos = 1, DecPos = 2,
    MagPos = 12 }),
    MaxObjects = 1000
}
```

Example query parameters.

J2kEquinox

readonly string Umbrella2.Pipeline.ExtraIO.Vizier.CommonDefaults.J2kEquinox = "J2000" [static]

J2000 equinox value.

RadialSortOrder

```
readonly string Umbrella2.Pipeline.ExtraIO.Vizier.CommonDefaults.RadialSortOrder = "_r" [static]
```

Sort stars by radial distance from the center of the search area.

ServerMap

```
readonly Dictionary<ServerShorthand, string> Umbrella2.Pipeline.ExtraIO.Vizier.CommonDefaults.←
ServerMap [static]
```

Initial value:

```
= new Dictionary<ServerShorthand, string>()
{
    [ServerShorthand.CDSGermany] = "https://vizier.cds.unistra.fr/viz-bin/",
    [ServerShorthand.CDSOld] = "http://vizier.u-strasbg.fr/viz-bin/",
    [ServerShorthand.ADACJapan] = "http://vizier.nao.ac.jp/viz-bin/",
    [ServerShorthand.IUCAAIIndia] = "https://vizier.iucaa.in/viz-bin/",
    [ServerShorthand.INASANRussia] = "https://vizier.inasan.ru/viz-bin/",
    [ServerShorthand.NAOCChina] = "http://vizier.china-vo.org/viz-bin/",
    [ServerShorthand.HarvardUSA] = "https://vizier.cfa.harvard.edu/viz-bin/",
    [ServerShorthand.IDIASouthAfrica] = "http://vizier.idia.ac.za/viz-bin/",
    [ServerShorthand.CambridgeUKOld] = "http://vizier.ast.cam.ac.uk/viz-bin/",
}
```

Mapping of [VizieR](#) server shorthands to their base URLs. May not be up to date.

ServerShortMap

```
readonly Dictionary<string, ServerShorthand> Umbrella2.Pipeline.ExtraIO.Vizier.CommonDefaults.←
ServerShortMap = GenerateEnumMap<ServerShorthand>() [static]
```

Map of shorthand strings to their enum value.

2.22 Umbrella2.Algorithms.Misc.ConnectedComponentGraph< T > Class Template Reference

Graph data structure to find groupings of objects.

Classes

- class [GNode](#)

Public Member Functions

- [ConnectedComponentGraph](#) (List< T > ObjectList, Func< T, T, bool > EdgeGeneratingFunction)

Creates a [ConnectedComponentGraph](#) from a given set of objects.
- List< T >[] [GetConnectedComponents](#) ()

Retrieves the objects grouped.

Private Member Functions

- void [FollowConnectedComponent](#) (int ZeroIndex, int ComponentNumber, int[] Components)
Marks objects from the same connected component.

Private Attributes

- T[] [Objects](#)
- Func< T, T, bool > [EdgeGenerator](#)
- [GNode\[\] Nodes](#)

2.22.1 Detailed Description

Graph data structure to find groupings of objects.

Template Parameters

<i>T</i>	Objects to be grouped.
----------	------------------------

2.22.2 Constructor & Destructor Documentation

ConnectedComponentGraph()

```
Umbrella2.Algorithms.Misc.ConnectedComponentGraph< T >.ConnectedComponentGraph (
    List< T > ObjectList,
    Func< T, T, bool > EdgeGeneratingFunction)
```

Creates a [ConnectedComponentGraph](#) from a given set of objects.

Parameters

<i>ObjectList</i>	List of objects to group.
<i>EdgeGeneratingFunction</i>	Topological binary distance function.

2.22.3 Member Function Documentation

FollowConnectedComponent()

```
void Umbrella2.Algorithms.Misc.ConnectedComponentGraph< T >.FollowConnectedComponent (
    int ZeroIndex,
    int ComponentNumber,
    int[] Components) [private]
```

Marks objects from the same connected component.

Parameters

<i>ZeroIndex</i>	Graph node index (in Nodes).
<i>ComponentNumber</i>	Object grouping number.
<i>Components</i>	List of groupings.

GetConnectedComponents()

```
List< T >[] Umbrella2.Algorithms.Misc.ConnectedComponentGraph< T >.GetConnectedComponents ()
```

Retrieves the objects grouped.

Returns

2.22.4 Member Data Documentation**EdgeGenerator**

```
Func<T, T, bool> Umbrella2.Algorithms.Misc.ConnectedComponentGraph< T >.EdgeGenerator [private]
```

Nodes

```
GNode [] Umbrella2.Algorithms.Misc.ConnectedComponentGraph< T >.Nodes [private]
```

Objects

```
T [] Umbrella2.Algorithms.Misc.ConnectedComponentGraph< T >.Objects [private]
```

2.23 Umbrella2.Pipeline.ExtraIO.Ades.ContextGroupAttribute Class Reference

Represents a group in the observation context. These groups are separate from each other within the observation context.

Public Member Functions

- [ContextGroupAttribute](#) (string groupName)

Public Member Functions inherited from [Umbrella2.Pipeline.ExtraIO.Ades.GroupAttribute](#)

- [GroupAttribute](#) (string groupName, bool nest)

Additional Inherited Members

Public Attributes inherited from [Umbrella2.Pipeline.ExtraIO.Ades.GroupAttribute](#)

- string [GroupName](#)
Name of the group, as shown in ADES specification.
- bool [Nest](#)
If `true` nest, otherwise flatten the XML hierarchy.

2.23.1 Detailed Description

Represents a group in the observation context. These groups are separate from each other within the observation context.

2.23.2 Constructor & Destructor Documentation

ContextGroupAttribute()

```
Umbrella2.Pipeline.ExtraIO.Ades.ContextGroupAttribute.ContextGroupAttribute (
    string groupName)
```

2.24 Umbrella2.Algorithms.Filtering.BadzoneFilter.ConvexPolygon Struct Reference

Public Member Functions

- bool [IsInside](#) ([PixelPoint](#) Point)

Package Attributes

- [PixelPoint](#)[] [Vertices](#)

2.24.1 Member Function Documentation

IsInside()

```
bool Umbrella2.Algorithms.Filtering.BadzoneFilter.ConvexPolygon.IsInside (
    PixelPoint Point)
```

2.24.2 Member Data Documentation

Vertices

```
PixelPoint [] Umbrella2.Algorithms.Filtering.BadzoneFilter.ConvexPolygon.Vertices [package]
```


2.25 Umbrella2.Algorithms.Images.CoreFilter Class Reference

Classes

- class [CoreFilterParameters](#)

Static Public Member Functions

- static AlgorithmRunParameters [Parameters](#) (int PSFRadius)

Static Public Attributes

- static readonly PositionDependentMap< [CoreFilterParameters](#) > [Filter](#) = [CoreFilterAlgorithm](#)

Static Private Member Functions

- static void [CoreFilterAlgorithm](#) (double[,] Input, double[,] Output, ImageSegmentPosition InputPosition, ImageSegmentPosition OutPos, [CoreFilterParameters](#) FilterParameters)

2.25.1 Member Function Documentation

CoreFilterAlgorithm()

```
static void Umbrella2.Algorithms.Images.CoreFilter.CoreFilterAlgorithm (
    double Input[,],
    double Output[,],
    ImageSegmentPosition InputPosition,
    ImageSegmentPosition OutPos,
    CoreFilterParameters FilterParameters) [static], [private]
```

Parameters()

```
static AlgorithmRunParameters Umbrella2.Algorithms.Images.CoreFilter.Parameters (
    int PSFRadius) [static]
```

2.25.2 Member Data Documentation

Filter

```
readonly PositionDependentMap<CoreFilterParameters> Umbrella2.Algorithms.Images.CoreFilter.↔
Filter = CoreFilterAlgorithm [static]
```

2.26 Umbrella2.Algorithms.Images.CoreFilter.CoreFilterParameters Class Reference

Public Member Functions

- [CoreFilterParameters](#) (double[] Weights, BitArray[] BadpixelMask)

Package Attributes

- [double\[\] PSF](#)
- [BitArray\[\] Mask](#)

2.26.1 Constructor & Destructor Documentation

CoreFilterParameters()

```
Umbrella2.Algorithms.Images.CoreFilter.CoreFilterParameters.CoreFilterParameters (
    double[] Weights,
    BitArray[] BadpixelMask)
```

2.26.2 Member Data Documentation

Mask

```
BitArray [] Umbrella2.Algorithms.Images.CoreFilter.CoreFilterParameters.Mask [package]
```

PSF

```
double [] Umbrella2.Algorithms.Images.CoreFilter.CoreFilterParameters.PSF [package]
```

2.27 Umbrella2.Pipeline.ExtraIO.Ades.CoreStructureAttribute Class Reference

Represents an ADES node that is a core part of an ADES document.

Public Member Functions

- [CoreStructureAttribute](#) (string groupName)

Public Member Functions inherited from [Umbrella2.Pipeline.ExtraIO.Ades.GroupAttribute](#)

- [GroupAttribute](#) (string groupName, bool nest)

Additional Inherited Members

Public Attributes inherited from [Umbrella2.Pipeline.ExtraIO.Ades.GroupAttribute](#)

- string [GroupName](#)
Name of the group, as shown in ADES specification.
- bool [Nest](#)
If `true` nest, otherwise flatten the XML hierarchy.

2.27.1 Detailed Description

Represents an ADES node that is a core part of an ADES document.

2.27.2 Constructor & Destructor Documentation

CoreStructureAttribute()

```
Umbrella2.Pipeline.ExtraIO.Ades.CoreStructureAttribute.CoreStructureAttribute (
    string groupName)
```

2.28 Umbrella2.Algorithms.Images.Schedulers.CPUParallel Class Reference

Static Public Member Functions

- static void [Scheduler](#) (RunDetails Details)

Static Private Member Functions

- static void [ProcessBlock](#) (RunDetails RunDetails, ref ThreadDetails ThDetails)
Process a block of data.
- static void [CallAlgorithm](#) (RunDetails Details, [ImageData\[\]](#) Inputs, [ImageData](#) Output)
Calls the algorithm code (depending on its type).

2.28.1 Member Function Documentation

CallAlgorithm()

```
static void Umbrella2.Algorithms.Images.Schedulers.CPUParallel.CallAlgorithm (
    RunDetails Details,
    ImageData[] Inputs,
    ImageData Output) [static], [private]
```

Calls the algorithm code (depending on its type).

ProcessBlock()

```
static void Umbrella2.Algorithms.Images.Schedulers.CPUParallel.ProcessBlock (
    RunDetails RunDetails,
    ref ThreadDetails ThDetails) [static], [private]
```

Process a block of data.

Parameters

<i>RunDetails</i>	Thread-common run parameters.
<i>ThDetails</i>	Thread-specific run parameters.

Scheduler()

```
static void Umbrella2.Algorithms.Images.Schedulers.CPUParallel.Scheduler (
    RunDetails Details) [static]
```

2.29 Umbrella2.Pipeline.ExtraIO.DataTable Class Reference

Public Member Functions

- [DataTable](#) (XElement [TableElement](#))
- override string [ToString](#) ()

Public Attributes

- string [Name](#)
- List< [FieldParam](#) > [Params](#)
- List< [FieldParam](#) > [Fields](#)
- XElement [TableData](#)
- string[][] [TableEntries](#)

2.29.1 Constructor & Destructor Documentation

DataTable()

```
Umbrella2.Pipeline.ExtraIO.DataTable.DataTable (
    XElement TableElement)
```

2.29.2 Member Function Documentation

ToString()

```
override string Umbrella2.Pipeline.ExtraIO.DataTable.ToString ()
```

2.29.3 Member Data Documentation

Fields

```
List<FieldParam> Umbrella2.Pipeline.ExtraIO.DataTable.Fields
```

Name

```
string Umbrella2.Pipeline.ExtraIO.DataTable.Name
```

Params

```
List<FieldParam> Umbrella2.Pipeline.ExtraIO.DataTable.Params
```

TableData

```
XElement Umbrella2.Pipeline.ExtraIO.DataTable.TableData
```

TableEntries

```
string [][] Umbrella2.Pipeline.ExtraIO.DataTable.TableEntries
```

2.30 Umbrella2.Algorithms.Images.LineAnalyzer.DetectionBlob Struct Reference

Represents a detected light blob.

Package Attributes

- List< [IntPoint](#) > [Points](#)
Coordinates of the blob's pixels.
- double [LineStart](#)
Projection on the line of the point closest to the origin.
- double [LineEnd](#)
Projection on the line of the point farthest from the origin.

2.30.1 Detailed Description

Represents a detected light blob.

2.30.2 Member Data Documentation

LineEnd

```
double Umbrella2.Algorithms.Images.LineAnalyzer.DetectionBlob.LineEnd [package]
```

Projection on the line of the point farthest from the origin.

LineStart

```
double Umbrella2.Algorithms.Images.LineAnalyzer.DetectionBlob.LineStart [package]
```

Projection on the line of the point closest to the origin.

Points

`List<IntPoint>` Umbrella2.Algorithms.Images.LineAnalyzer.DetectionBlob.Points [package]

Coordinates of the blob's pixels.

2.31 Umbrella2.Algorithms.Pairing.DetectionReducer Class Reference

Provides support for removing fixed stars from a set of detections.

Public Member Functions

- [DetectionReducer](#) ()
- void [LoadStars](#) (List< [Star](#) > Detections)
Preloads stars into the search structures.
- void [GeneratePool](#) ()
Generates the search structures.
- List< [ImageDetection](#) > [Reduce](#) (List< [ImageDetection](#) > Input)
Removes fixed stars from a list of detections.

Public Attributes

- double [PairingRadius](#) = 2

Protected Attributes

- [QuadTree](#)< [Star](#) > [DetectionPool](#)
Quad Tree that represents the source pool.
- readonly List< [Star](#) > [PoolList](#)
List of the sources in the pool.

Private Attributes

- double [Topmost](#)
- double [Lowermost](#)
- double [Leftmost](#)
- double [Rightmost](#)
- double [MaxRadius](#) = 0

Static Private Attributes

- const int [PoolDepth](#) = 10
Depth of the quad tree.

2.31.1 Detailed Description

Provides support for removing fixed stars from a set of detections.

2.31.2 Constructor & Destructor Documentation

DetectionReducer()

```
Umbrella2.Algorithms.Pairing.DetectionReducer.DetectionReducer ()
```

2.31.3 Member Function Documentation

GeneratePool()

```
void Umbrella2.Algorithms.Pairing.DetectionReducer.GeneratePool ()
```

Generates the search structures.

LoadStars()

```
void Umbrella2.Algorithms.Pairing.DetectionReducer.LoadStars (  
    List< Star > Detections)
```

Preloads stars into the search structures.

Parameters

<i>Detections</i>	Stars.
-------------------	--------

Reduce()

```
List< ImageDetection > Umbrella2.Algorithms.Pairing.DetectionReducer.Reduce (  
    List< ImageDetection > Input)
```

Removes fixed stars from a list of detections.

Returns

Reduced detections.

Parameters

<i>Input</i>	Raw detections.
--------------	-----------------

2.31.4 Member Data Documentation

DetectionPool

```
QuadTree<Star> Umbrella2.Algorithms.Pairing.DetectionReducer.DetectionPool [protected]
```

Quad Tree that represents the source pool.

Leftmost

```
double Umbrella2.Algorithms.Pairing.DetectionReducer.Leftmost [private]
```

Lowermost

```
double Umbrella2.Algorithms.Pairing.DetectionReducer.Lowermost [private]
```

MaxRadius

```
double Umbrella2.Algorithms.Pairing.DetectionReducer.MaxRadius = 0 [private]
```

PairingRadius

```
double Umbrella2.Algorithms.Pairing.DetectionReducer.PairingRadius = 2
```

PoolDepth

```
const int Umbrella2.Algorithms.Pairing.DetectionReducer.PoolDepth = 10 [static], [private]
```

Depth of the quad tree.

PoolList

```
readonly List<Star> Umbrella2.Algorithms.Pairing.DetectionReducer.PoolList [protected]
```

List of the sources in the pool.

Rightmost

```
double Umbrella2.Algorithms.Pairing.DetectionReducer.Rightmost [private]
```

Topmost

```
double Umbrella2.Algorithms.Pairing.DetectionReducer.Topmost [private]
```

2.32 Umbrella2.Algorithms.Images.LineAnalyzer.DetectionSegment Struct Reference

A candidate line segment detection.

Package Attributes

- List< [DetectionBlob](#) > [Blobs](#)
List of blobs that make up the line segment.
- double [Angle](#)
Angle of the segment.
- double [Start](#)
Projection on the line of the point closest to origin.
- double [End](#)
Projection on the line of the point farthest from origin.

2.32.1 Detailed Description

A candidate line segment detection.

2.32.2 Member Data Documentation

Angle

```
double Umbrella2.Algorithms.Images.LineAnalyzer.DetectionSegment.Angle [package]
```

Angle of the segment.

Blobs

```
List<DetectionBlob> Umbrella2.Algorithms.Images.LineAnalyzer.DetectionSegment.Blobs [package]
```

List of blobs that make up the line segment.

End

```
double Umbrella2.Algorithms.Images.LineAnalyzer.DetectionSegment.End [package]
```

Projection on the line of the point farthest from origin.

Start

```
double Umbrella2.Algorithms.Images.LineAnalyzer.DetectionSegment.Start [package]
```

Projection on the line of the point closest to origin.

2.33 Umbrella2.Algorithms.Detection.DotDetector.DotDetection Struct Reference

Holds the data of a light source.

Public Member Functions

- override string [ToString](#) ()

Public Attributes

- [PixelPoint Barycenter](#)
Flux-weighted mean of the detected pixels.
- List< [PixelPoint](#) > [Pixels](#)
Coordinates of the pixels detected.
- List< double > [PixelValues](#)
Flux values for the pixels in [Pixels](#) as recorded in the image.
- [PixelPoint PixelCenter](#)
Direct mean of pixel positions.
- double [Flux](#)
Total flux, the sum of all [PixelValues](#).

2.33.1 Detailed Description

Holds the data of a light source.

2.33.2 Member Function Documentation

ToString()

```
override string Umbrella2.Algorithms.Detection.DotDetector.DotDetection.ToString ()
```

2.33.3 Member Data Documentation

Barycenter

```
PixelPoint Umbrella2.Algorithms.Detection.DotDetector.DotDetection.Barycenter
```

Flux-weighted mean of the detected pixels.

Flux

```
double Umbrella2.Algorithms.Detection.DotDetector.DotDetection.Flux
```

Total flux, the sum of all [PixelValues](#).

PixelCenter

```
PixelPoint Umbrella2.Algorithms.Detection.DotDetector.DotDetection.PixelCenter
```

Direct mean of pixel positions.

Pixels

```
List<PixelPoint> Umbrella2.Algorithms.Detection.DotDetector.DotDetection.Pixels
```

Coordinates of the pixels detected.

PixelValues

```
List<double> Umbrella2.Algorithms.Detection.DotDetector.DotDetection.PixelValues
```

Flux values for the pixels in [Pixels](#) as recorded in the image.

2.34 Umbrella2.Algorithms.Detection.DotDetector Class Reference

Connected component hysteresis algorithm for light source detection.

Classes

- struct [DotDetection](#)
Holds the data of a light source.
- struct [IntPoint](#)
Integer lattice point.

Public Member Functions

- List< [ImageDetection](#) > [Detect](#) ([Image](#) Input)
Detects light sources on the input image using hysteresis thresholding. Requires input image to be astrometrically reduced.
- List< [DotDetection](#) > [DetectRaw](#) ([Image](#) Input)
Detects light sources on the input image. This form can be used on raw images.

Public Attributes

- double [HighThresholdMultiplier](#)
Upper hysteresis in (local) standard deviations.
- double [LowThresholdMultiplier](#)
Lower hysteresis in (local) standard deviations.
- double [MinPix](#)
Minimum number of pixels to consider a detection.
- double [NonrepresentativeThreshold](#)
The maximum value a pixel can take before being excluded from the local mean.
- AlgorithmRunParameters [Parameters](#)
ParallelAlgorithm options.

Static Package Functions

- static [DotDetection BitmapFill](#) (double[,] Input, [IntPoint](#) StartPoint, bool[,] Mask, double LowThreshold, int OX, int OY)

Connected component / bitmap fill function.

Static Private Member Functions

- static void [DetectSources](#) (double[,] Input, ImageSegmentPosition [Position](#), [DotDetector](#) Instance)

Actual detection function for trailless light sources.

Private Attributes

- List< [DotDetection](#) > [Detections](#)

List of unprocessed detections.

2.34.1 Detailed Description

Connected component hysteresis algorithm for light source detection.

2.34.2 Member Function Documentation

BitmapFill()

```
static DotDetection Umbrella2.Algorithms.Detection.DotDetector.BitmapFill (
    double Input[,],
    IntPoint StartPoint,
    bool Mask[,],
    double LowThreshold,
    int OX,
    int OY) [static], [package]
```

Connected component / bitmap fill function.

Parameters

<i>Input</i>	Image input
<i>StartPoint</i>	Starting coordinates.
<i>Mask</i>	Mask of visited coordinates.
<i>LowThreshold</i>	Lower hysteresis threshold.
<i>OX</i>	X origin delta.
<i>OY</i>	Y origin delta.

Returns

Detect()

```
List< ImageDetection > Umbrella2.Algorithms.Detection.DotDetector.Detect (
    Image Input)
```

Detects light sources on the input image using hysteresis thresholding. Requires input image to be astrometrically reduced.

Parameters

<i>Input</i>	Input image.
--------------	--------------

Returns

A list of detections.

DetectRaw()

```
List< DotDetection > Umbrella2.Algorithms.Detection.DotDetector.DetectRaw (
    Image Input)
```

Detects light sources on the input image. This form can be used on raw images.

Parameters

<i>Input</i>	Input image.
--------------	--------------

Returns

A list of the detected blobs.

DetectSources()

```
static void Umbrella2.Algorithms.Detection.DotDetector.DetectSources (
    double Input[,],
    ImageSegmentPosition Position,
    DotDetector Instance) [static], [private]
```

Actual detection function for trailless light sources.

Parameters

<i>Input</i>	Input image data.
<i>Position</i>	Data position in the image.
<i>Instance</i>	DotDetector instance in which this is called.

2.34.3 Member Data Documentation**Detections**

```
List<DotDetection> Umbrella2.Algorithms.Detection.DotDetector.Detections [private]
```

List of unprocessed detections.

HighThresholdMultiplier

```
double Umbrella2.Algorithms.Detection.DotDetector.HighThresholdMultiplier
```

Upper hysteresis in (local) standard deviations.

LowThresholdMultiplier

```
double Umbrella2.Algorithms.Detection.DotDetector.LowThresholdMultiplier
```

Lower hysteresis in (local) standard deviations.

MinPix

```
double Umbrella2.Algorithms.Detection.DotDetector.MinPix
```

Minimum number of pixels to consider a detection.

NonrepresentativeThreshold

```
double Umbrella2.Algorithms.Detection.DotDetector.NonrepresentativeThreshold
```

The maximum value a pixel can take before being excluded from the local mean.

Parameters

```
AlgorithmRunParameters Umbrella2.Algorithms.Detection.DotDetector.Parameters
```

Initial value:

```
= new AlgorithmRunParameters ()
{
    FillZero = true,
    InputMargins = 0,
    Xstep = 200,
    Ystep = 50
}
```

ParallelAlgorithm options.

2.35 Umbrella2.Pipeline.ExtraIO.Ades.ElementAttribute Class Reference

An ADES element, which is an individual piece of data.

Public Member Functions

- [ElementAttribute](#) (string elementName, bool repeatedEntry=false, string format=null)

Public Attributes

- string [ElementName](#)
Name of the element, as defined in the ADES specification.
- bool [RepeatedEntry](#)
Whether the entry can repeat; in which case it should be an array of the element type.
- string [StringFormat](#)
Formatting string. Duck-typed to `string ToString(string)`.

2.35.1 Detailed Description

An ADES element, which is an individual piece of data.

2.35.2 Constructor & Destructor Documentation

ElementAttribute()

```
Umbrella2.Pipeline.ExtraIO.Ades.ElementAttribute.ElementAttribute (  
    string elementName,  
    bool repeatedEntry = false,  
    string format = null)
```

2.35.3 Member Data Documentation

ElementName

```
string Umbrella2.Pipeline.ExtraIO.Ades.ElementAttribute.ElementName
```

Name of the element, as defined in the ADES specification.

RepeatedEntry

```
bool Umbrella2.Pipeline.ExtraIO.Ades.ElementAttribute.RepeatedEntry
```

Whether the entry can repeat; in which case it should be an array of the element type.

StringFormat

```
string Umbrella2.Pipeline.ExtraIO.Ades.ElementAttribute.StringFormat
```

Formatting string. Duck-typed to `string ToString(string)`.

2.36 Umbrella2.Pipeline.ExtraIO.Ades.EntryXmlAttribute Class Reference

Represent an XML attribute for an ADES node.

Public Member Functions

- [EntryXmlAttributeAttribute](#) (string name, string value)

Public Attributes

- string [Name](#)
Name (key) of the attribute.
- string [Value](#)
Value of the attribute (XML-encoded).

2.36.1 Detailed Description

Represent an XML attribute for an ADES node.

2.36.2 Constructor & Destructor Documentation

EntryXmlAttributeAttribute()

```
Umbrella2.Pipeline.ExtraIO.Ades.EntryXmlAttributeAttribute.EntryXmlAttributeAttribute (  
    string name,  
    string value)
```

2.36.3 Member Data Documentation

Name

```
string Umbrella2.Pipeline.ExtraIO.Ades.EntryXmlAttributeAttribute.Name
```

Name (key) of the attribute.

Value

```
string Umbrella2.Pipeline.ExtraIO.Ades.EntryXmlAttributeAttribute.Value
```

Value of the attribute (XML-encoded).

2.37 Umbrella2.WCS.EquatorialDistance Class Reference

Functions for computing distances on spherical coordinates.

Classes

- struct [GreatLine](#)
Defines a spherical line segment / arc of a great circle.
- struct [Vector3D](#)
Represents a 3D vector.

Static Public Member Functions

- static double `GetDistance` (`EquatorialPoint A`, `EquatorialPoint B`)
Returns the spherical distance between 2 points on the sphere.
- static `EquatorialPoint GetGreatCircleWaypoint` (`EquatorialPoint A`, `EquatorialPoint B`, double `Distance`)
Provides great circle navigation.

2.37.1 Detailed Description

Functions for computing distances on spherical coordinates.

2.37.2 Member Function Documentation

GetDistance()

```
static double Umbrella2.WCS.EquatorialDistance.GetDistance (
    EquatorialPoint A,
    EquatorialPoint B) [static]
```

Returns the spherical distance between 2 points on the sphere.

GetGreatCircleWaypoint()

```
static EquatorialPoint Umbrella2.WCS.EquatorialDistance.GetGreatCircleWaypoint (
    EquatorialPoint A,
    EquatorialPoint B,
    double Distance) [static]
```

Provides great circle navigation.

Parameters

<i>A</i>	Endpoint.
<i>B</i>	Startpoint.
<i>Distance</i>	Distance to navigate.

Returns

The point `Distance` away from `B` on the great circle defined by `A` and `B`.

2.38 Umbrella2.EquatorialPoint Struct Reference

Point representing a point on the equatorial coordinate system.

Static Public Member Functions

- static double `operator^` (`EquatorialPoint` a, `EquatorialPoint` b)
Computes the distance between 2 equatorial points.
- static `WCS.EquatorialDistance.GreatLine operator-` (`EquatorialPoint` a, `EquatorialPoint` b)
Computes the great circle through 2 equatorial points.

Public Attributes

- double `RA`
- double `Dec`

Properties

- string `MPCForm` [get]

2.38.1 Detailed Description

Point representing a point on the equatorial coordinate system.

2.38.2 Member Function Documentation

`operator-`()

```
static WCS.EquatorialDistance.GreatLine Umbrella2.EquatorialPoint.operator- (  
    EquatorialPoint a,  
    EquatorialPoint b) [static]
```

Computes the great circle through 2 equatorial points.

Returns

An instance of `GreatLine` that represents the great circle generated by the given points.

`operator^`()

```
static double Umbrella2.EquatorialPoint.operator^ (  
    EquatorialPoint a,  
    EquatorialPoint b) [static]
```

Computes the distance between 2 equatorial points.

Returns

The distance in radians.

2.38.3 Member Data Documentation

Dec

```
double Umbrella2.EquatorialPoint.Dec
```

RA

```
double Umbrella2.EquatorialPoint.RA
```

2.38.4 Property Documentation

MPCForm

```
string Umbrella2.EquatorialPoint.MPCForm [get], [private]
```

2.39 Umbrella2.EquatorialPointStringFormatter Class Reference

Converts EquatorialPoints to strings and back.

Public Types

- enum [Format](#) {
[MPC](#) , [MPC_RA](#) , [MPC_Dec](#) , [RadSpace](#) ,
[RadExplicit](#) , [MPC_Tab](#) }
Format to output string in.

Static Public Member Functions

- static string [FormatToString](#) (this [EquatorialPoint](#) Point, [Format](#) OutputFormat)
Formats point to string.
- static [EquatorialPoint](#) [ParseFromMPCString](#) (string Point)
Parses a MPC string into an [EquatorialPoint](#).

Static Private Member Functions

- static string [RASexa](#) (double a)
Computes the 24h sexagesimal format of the Right Ascension.
- static string [DecSexa](#) (double a)
Computes the 180 degrees sexagesimal format of the Declination.

2.39.1 Detailed Description

Converts EquatorialPoints to strings and back.

2.39.2 Member Enumeration Documentation

Format

```
enum Umbrella2.EquatorialPointStringFormatter.Format
```

Format to output string in.

Enumerator

MPC	MPC standard format.
MPC_RA	MPC Right Ascension only.
MPC_Dec	MPC Declination only.
RadSpace	Radians, space separated.
RadExplicit	Radians, explicit RA/Dec.
MPC_Tab	MPC, but tab-separated.

2.39.3 Member Function Documentation

DecSexa()

```
static string Umbrella2.EquatorialPointStringFormatter.DecSexa (
    double a) [static], [private]
```

Computes the 180 degrees sexagesimal format of the Declination.

Parameters

<i>a</i>	Declination (in radians).
----------	---------------------------

Returns

A string containing the 180 degree format of the input.

FormatToString()

```
static string Umbrella2.EquatorialPointStringFormatter.FormatToString (
    this EquatorialPoint Point,
    Format OutputFormat) [static]
```

Formats point to string.

Parameters

<i>Point</i>	Point to apply to.
<i>OutputFormat</i>	String output format.

Returns

A formatted string containing the coordinates of the input point.

ParseFromMPCString()

```
static EquatorialPoint Umbrella2.EquatorialPointStringFormatter.ParseFromMPCString (
    string Point) [static]
```

Parses a MPC string into an [EquatorialPoint](#).

Parameters

<i>Point</i>	MPC-style coordinate string.
--------------	------------------------------

Returns

[EquatorialPoint](#) with specified coordinates.

RASexa()

```
static string Umbrella2.EquatorialPointStringFormatter.RASexa (  
    double a) [static], [private]
```

Computes the 24h sexagesimal format of the Right Ascension.

Parameters

<i>a</i>	Right Ascension (in radians).
----------	-------------------------------

Returns

A string containing the 24h format of the input.

2.40 Umbrella2.EquatorialVelocity Struct Reference

Velocity in the equatorial coordinate system.

Public Member Functions

- override string [ToString](#) ()

Public Attributes

- double [RAvel](#)
RA velocity in radians per second.
- double [Decvel](#)
Dec velocity in radians per second.

2.40.1 Detailed Description

Velocity in the equatorial coordinate system.

2.40.2 Member Function Documentation

ToString()

```
override string Umbrella2.EquatorialVelocity.ToString ()
```

2.40.3 Member Data Documentation

Decvel

```
double Umbrella2.EquatorialVelocity.Decvel
```

Dec velocity in radians per second.

RAvel

```
double Umbrella2.EquatorialVelocity.RAvel
```

RA velocity in radians per second.

2.41 Umbrella2.Algorithms.Images.Median.EstimatorFR Class Reference

A median computation method that applies a Floyd-Rivest partitioning using estimated pivots before applying Quickselect.

Static Public Member Functions

- static void [EstimatorFRMedian](#) (double[,] Input, double[,] Output, double[] PSF)
Computes the weighted median of the input.

Static Package Functions

- unsafe static int [FFRSelectZero](#) (double[,] Input, double[] InputWeights, int i, int j, int Size, double UTh, double DTh, double *Values, double *VWeights, out double LowerW, out int LowI, out double HigherW, out int HighI)
Selects input pixels in a given interval.
- unsafe static double [CallQsel](#) (double *SelectedInput, double *Weights, int Count, double LowerW, int LowI, double HigherW, int HighI)
Calls Quickselect to find the median.

Properties

- static double [AvgQselCount](#) [get]

Static Private Attributes

- static double [SDCountD](#) = 0.35
Amount of standard deviations to include downwards.
- static double [SDCountU](#) = 0.3
Amount of standard deviations to include upwards.
- static double [IndistinguishableWeight](#) = Math.Pow(10, -6)
Weight threshold for the eventual float rounding mismatches.
- static long [AvCount](#) = 0
Number of input pixels passing through to quickselect.
- static long [AvRun](#) = 0
Number of output pixels processed.
- static long [CPred](#) = 0
Number of median prediction hits.

2.41.1 Detailed Description

A median computation method that applies a Floyd-Rivest partitioning using estimated pivots before applying Quickselect.

2.41.2 Member Function Documentation

CallQsel()

```
unsafe static double Umbrella2.Algorithms.Images.Median.EstimatorFR.CallQsel (
    double * SelectedInput,
    double * Weights,
    int Count,
    double LowerW,
    int LowI,
    double HigherW,
    int HighI) [static], [package]
```

Calls Quickselect to find the median.

Parameters

<i>SelectedInput</i>	Input values array.
<i>Weights</i>	Input weights array.
<i>Count</i>	Amount of input data.
<i>LowerW</i>	Sum of weights for values smaller than the selected ones.
<i>LowI</i>	Index of the smallest value.
<i>HigherW</i>	Sum of weights for values larger than the selected ones.
<i>HighI</i>	Index of the highest value.

Returns

The median of the input values.

EstimatorFRMedian()

```
static void Umbrella2.Algorithms.Images.Median.EstimatorFR.EstimatorFRMedian (
    double Input[,],
    double Output[,],
    double[] PSF) [static]
```

Computes the weighted median of the input.

Parameters

<i>Input</i>	Input data.
<i>Output</i>	Output data.
<i>PSF</i>	PSF importance distribution / median weights.

FFRSelectZero()

```
unsafe static int Umbrella2.Algorithms.Images.Median.EstimatorFR.FFRSelectZero (  
    double Input[,],  
    double[] InputWeights,  
    int i,  
    int j,  
    int Size,  
    double UTh,  
    double DTh,  
    double * Values,  
    double * VWeights,  
    out double LowerW,  
    out int LowI,  
    out double HigherW,  
    out int HighI) [static], [package]
```

Selects input pixels in a given interval.

Returns

Number of selected input pixels.

2.41.3 Member Data Documentation

AvCount

```
long Umbrella2.Algorithms.Images.Median.EstimatorFR.AvCount = 0 [static], [private]
```

Number of input pixels passing through to quickselect.

AvRun

```
long Umbrella2.Algorithms.Images.Median.EstimatorFR.AvRun = 0 [static], [private]
```

Number of output pixels processed.

CPred

```
long Umbrella2.Algorithms.Images.Median.EstimatorFR.CPred = 0 [static], [private]
```

Number of median prediction hits.

IndistinguishableWeight

```
double Umbrella2.Algorithms.Images.Median.EstimatorFR.IndistinguishableWeight = Math.Pow(10,  
-6) [static], [private]
```

Weight threshold for the eventual float rounding mismatches.

SDCountD

```
double Umbrella2.Algorithms.Images.Median.EstimatorFR.SDCountD = 0.35 [static], [private]
```

Amount of standard deviations to include downwards.

SDCountU

```
double Umbrella2.Algorithms.Images.Median.EstimatorFR.SDCountU = 0.3 [static], [private]
```

Amount of standard deviations to include upwards.

2.41.4 Property Documentation**AvgQselCount**

```
double Umbrella2.Algorithms.Images.Median.EstimatorFR.AvgQselCount [static], [get], [private]
```

2.42 Umbrella2.Algorithms.Schedulers.ExtensionMethods Class Reference**Static Public Member Functions**

- static void [RunAlgorithm< T >](#) (Extractor< T > Algorithm, T Argument, [Image](#) Input, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [RunAlgorithm< T >](#) (PositionDependentExtractor< T > Algorithm, T Argument, [Image](#) Input, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [RunAlgorithm< T >](#) (SimpleMap< T > Algorithm, T Argument, [Image](#) Input, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [RunAlgorithm< T, U >](#) (SimpleMap< T, U > Algorithm, T Argument1, U Argument2, [Image](#) Input, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [RunAlgorithm< T, U, V >](#) (SimpleMap< T, U, V > Algorithm, T Argument1, U Argument2, V Argument3, [Image](#) Input, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [RunAlgorithm< T >](#) (PositionDependentMap< T > Algorithm, T Argument, [Image](#) Input, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [RunAlgorithm< T >](#) (Combiner< T > Algorithm, T Argument, [Image](#)[] Inputs, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.

2.42.1 Member Function Documentation**RunAlgorithm< T >() [1/5]**

```
static void Umbrella2.Algorithms.Schedulers.ExtensionMethods.RunAlgorithm< T > (
    Combiner< T > Algorithm,
    T Argument,
    Image[] Inputs,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	Extra parameter type.
----------	-----------------------

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument</i>	Argument to be passed to all invocations.
<i>Inputs</i>	Input images.
<i>Output</i>	Output image.
<i>Parameters</i>	Parameters of the algorithm run.

RunAlgorithm< T >() [2/5]

```
static void Umbrella2.Algorithms.Schedulers.ExtensionMethods.RunAlgorithm< T > (
    Extractor< T > Algorithm,
    T Argument,
    Image Input,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	Extra parameter type.
----------	-----------------------

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument</i>	Argument to be passed to all invocations.
<i>Input</i>	Input image.
<i>Parameters</i>	Parameters of the algorithm run.

RunAlgorithm< T >() [3/5]

```
static void Umbrella2.Algorithms.Schedulers.ExtensionMethods.RunAlgorithm< T > (
    PositionDependentExtractor< T > Algorithm,
    T Argument,
    Image Input,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	Extra parameter type.
----------	-----------------------

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument</i>	Argument to be passed to all invocations.
<i>Input</i>	Input image.
<i>Parameters</i>	Parameters of the algorithm run.

RunAlgorithm< T >() [4/5]

```
static void Umbrella2.Algorithms.Schedulers.ExtensionMethods.RunAlgorithm< T > (
    PositionDependentMap< T > Algorithm,
    T Argument,
    Image Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	Extra parameter type.
----------	-----------------------

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument</i>	Argument to be passed to all invocations.
<i>Input</i>	Input image.
<i>Output</i>	Output image.
<i>Parameters</i>	Parameters of the algorithm run.

RunAlgorithm< T >() [5/5]

```
static void Umbrella2.Algorithms.Schedulers.ExtensionMethods.RunAlgorithm< T > (
    SimpleMap< T > Algorithm,
    T Argument,
    Image Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	Extra parameter type.
----------	-----------------------

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument</i>	Argument to be passed to all invocations.
<i>Input</i>	Input image.
<i>Output</i>	Output image.
<i>Parameters</i>	Parameters of the algorithm run.

RunAlgorithm< T, U >()

```
static void Umbrella2.Algorithms.Schedulers.ExtensionMethods.RunAlgorithm< T, U > (
    SimpleMap< T, U > Algorithm,
    T Argument1,
    U Argument2,
    Image Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	First extra parameter type.
<i>U</i>	Second extra parameter type.

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument1</i>	First argument to be passed to all invocations.
<i>Argument2</i>	Second argument to be passed to all invocations.
<i>Input</i>	Input image.
<i>Output</i>	Output image.
<i>Parameters</i>	Parameters of the algorithm run.

RunAlgorithm< T, U, V >()

```
static void Umbrella2.Algorithms.Schedulers.ExtensionMethods.RunAlgorithm< T, U, V > (
    SimpleMap< T, U, V > Algorithm,
    T Argument1,
    U Argument2,
    V Argument3,
    Image Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	First extra parameter type.
<i>U</i>	Second extra parameter type.
<i>V</i>	Third extra parameter type.

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument1</i>	First argument to be passed to all invocations.
<i>Argument2</i>	Second argument to be passed to all invocations.

<i>Argument3</i>	Third argument to be passed to all invocations.
<i>Input</i>	Input image.
<i>Output</i>	Output image.
<i>Parameters</i>	Parameters of the algorithm run.

2.43 Umbrella2.IO.FITS.FICHV Class Reference

[FITS Image](#) Core Header Values. A wrapper for the core data in [FITS](#) Images' header data.

Public Member Functions

- [FICHV CloneCore](#) ([FICHV](#) Original)
Creates a shallow clone of the [FICHV](#), except for the header table, which is regenerated.
- [FICHV ChangeBitPix](#) (int [BitPix](#))
Changes the BITPIX entry of this header.

Public Attributes

- int [BitPix](#)
BITPIX value.

Public Attributes inherited from [Umbrella2.IO.ICHV](#)

- uint [Width](#)
Image width.
- uint [Height](#)
Image height.
- [IWCSProjection WCS](#)
Image WCS.
- HeaderTable [Header](#)
Header table.
- int [ImageNumber](#)
The number of the image in a multi-image file.

2.43.1 Detailed Description

[FITS Image](#) Core Header Values. A wrapper for the core data in [FITS](#) Images' header data.

2.43.2 Member Function Documentation

ChangeBitPix()

```
FICHV Umbrella2.IO.FITS.FICHV.ChangeBitPix (
    int BitPix)
```

Changes the BITPIX entry of this header.

Returns

This instance.

Parameters

<i>BitPix</i>	The new value for BitPix .
---------------	--

CloneCore()

```
FICHV Umbrella2.IO.FITS.FICHV.CloneCore (  
    FICHV Original)
```

Creates a shallow clone of the [FICHV](#), except for the header table, which is regenerated.

Parameters

<i>Original</i>	Header to clone.
-----------------	------------------

2.43.3 Member Data Documentation**BitPix**

```
int Umbrella2.IO.FITS.FICHV.BitPix
```

BITPIX value.

2.44 Umbrella2.Pipeline.ExtraIO.FieldParam Class Reference**Public Member Functions**

- [FieldParam](#) (int [Column](#), XElement [Element](#))
- override string [ToString](#) ()

Public Attributes

- int [Column](#)
- string [Name](#)
- string [DataType](#)
- string [UCD](#)
- string [Unit](#)
- string [Value](#)

2.44.1 Constructor & Destructor Documentation**FieldParam()**

```
Umbrella2.Pipeline.ExtraIO.FieldParam.FieldParam (  
    int Column,  
    XElement Element)
```

2.44.2 Member Function Documentation

ToString()

```
override string Umbrella2.Pipeline.ExtraIO.FieldParam.ToString ()
```

2.44.3 Member Data Documentation

Column

```
int Umbrella2.Pipeline.ExtraIO.FieldParam.Column
```

DataType

```
string Umbrella2.Pipeline.ExtraIO.FieldParam.DataType
```

Name

```
string Umbrella2.Pipeline.ExtraIO.FieldParam.Name
```

UCD

```
string Umbrella2.Pipeline.ExtraIO.FieldParam.UCD
```

Unit

```
string Umbrella2.Pipeline.ExtraIO.FieldParam.Unit
```

Value

```
string Umbrella2.Pipeline.ExtraIO.FieldParam.Value
```

2.45 Umbrella2.IO.FITS.FitsArgumentOutOfRangeException Class Reference

Exception raised when the value of a header record is outside the allowed or supported set of values.

Public Member Functions

- [FitsArgumentOutOfRangeException](#) (string keyword, string message)
Initializes a new instance of the `T:Umbrella2.IO.FITS.FitsArgumentOutOfRangeException` class.

Properties

- string [ProblemKeyword](#) [get, private set]

Keyword which triggered this issue. May be null. Note this may not always point to the problem record, as previous records may have put the parsing code in a state where this specific keyword is not valid, although normally it would be fine.

Properties inherited from [Umbrella2.IO.FITS.IFitsParsingError](#)

2.45.1 Detailed Description

Exception raised when the value of a header record is outside the allowed or supported set of values.

2.45.2 Constructor & Destructor Documentation

FitsArgumentOutOfRangeException()

```
Umbrella2.IO.FITS.FitsArgumentOutOfRangeException.FitsArgumentOutOfRangeException (
    string keyword,
    string message)
```

Initializes a new instance of the T:Umbrella2.IO.FITS.FitsArgumentOutOfRangeException class.

Parameters

<i>keyword</i>	Keyword of the record that raised the issue.
<i>message</i>	Reason why exception was thrown.

2.45.3 Property Documentation

ProblemKeyword

```
string Umbrella2.IO.FITS.FitsArgumentOutOfRangeException.ProblemKeyword [get], [private set]
```

Keyword which triggered this issue. May be null. Note this may not always point to the problem record, as previous records may have put the parsing code in a state where this specific keyword is not valid, although normally it would be fine.

Implements [Umbrella2.IO.FITS.IFitsParsingError](#).

2.46 Umbrella2.IO.FITS.FitsBuilder Class Reference

Provides functions for building [FITS](#) Images.

Static Public Member Functions

- static HeaderTable [GetHeader](#) ([FICHV](#) Core)
Computes the headers for a new [FITS](#) image.

Static Private Member Functions

- static Dictionary< string, string > [GetHeaderWithTransform](#) (FICHV Core, bool R_AFirst)
Computes the headers when the input image has WCS coordinates.
- static Dictionary< string, string > [GetHeaderWithoutTransform](#) (FICHV Core)
Computes the headers when the input image has no WCS information.

2.46.1 Detailed Description

Provides functions for building FITS Images.

2.46.2 Member Function Documentation

GetHeader()

```
static HeaderTable Umbrella2.IO.FITS.FitsBuilder.GetHeader (
    FICHV Core) [static]
```

Computes the headers for a new FITS image.

Parameters

Core	Header values.
------	----------------

Returns

A HeaderTable instance for the new FITS image.

GetHeaderWithoutTransform()

```
static Dictionary< string, string > Umbrella2.IO.FITS.FitsBuilder.GetHeaderWithoutTransform (
    FICHV Core) [static], [private]
```

Computes the headers when the input image has no WCS information.

GetHeaderWithTransform()

```
static Dictionary< string, string > Umbrella2.IO.FITS.FitsBuilder.GetHeaderWithTransform (
    FICHV Core,
    bool RAFirst) [static], [private]
```

Computes the headers when the input image has WCS coordinates.

2.47 Umbrella2.IO.FITS.FitsDriverException Class Reference

Represent an internal failure of the FITS handling code that may or may not be due to broken inputs.

Public Member Functions

- [FitsDriverException](#) (string message)

Properties

- string [ProblemKeyword](#) [get]
Always null.

Properties inherited from [Umbrella2.IO.FITS.IFitsParsingError](#)

2.47.1 Detailed Description

Represent an internal failure of the [FITS](#) handling code that may or may not be due to broken inputs.

2.47.2 Constructor & Destructor Documentation

[FitsDriverException\(\)](#)

```
Umbrella2.IO.FITS.FitsDriverException.FitsDriverException (  
    string message)
```

2.47.3 Property Documentation

[ProblemKeyword](#)

```
string Umbrella2.IO.FITS.FitsDriverException.ProblemKeyword [get]
```

Always null.

Implements [Umbrella2.IO.FITS.IFitsParsingError](#).

2.48 Umbrella2.IO.FITS.FitsFile Class Reference

A handle to a [FITS](#) File on the disk. Used to read/write data.

Public Member Functions

- delegate int [MEFImageNumberGetter](#) (int ExtensionNumber, HeaderTable Header)
- virtual void [Close](#) ()
Disposes of all handles and large in-memory resources.
- void [ReleaseResources](#) ()
Calls [ReleaseHandle](#).

Public Attributes

- readonly string [Path](#)
- readonly HeaderTable [PrimaryTable](#)
- readonly Dictionary< int, HeaderTable > [MEFHeaderTable](#)

Protected Member Functions

- [FitsFile](#) (string [Path](#), bool OutputImage, [MEFImageNumberGetter](#) numberGetter, [FitsFileBuilder](#) Headers)

Protected Attributes

- int [PrimaryDataPointer](#)
- readonly List< int > [ExtensionDataPointers](#)
- readonly Dictionary< int, int > [MEFDataPointers](#)
- readonly bool [OutputFile](#)

Package Functions

- unsafe IntPtr [GetView](#) (int [Position](#), int Length)
Memory-maps an area in the file.
- IntPtr [GetDataView](#) (int Dataset, int DSetPosition, int Length)
Memory maps image data.
- void [ReleaseView](#) (IntPtr View)
Releases the memory mapped file view (and associated resources).
- void [ReleaseHandle](#) ()
Releases the file handle. Writing may not occur after the release. Reading reopens the handle.

Static Package Functions

- static int [DefaultGetter](#) (int ExtensionNumber, HeaderTable Header)

Properties

- string [PathString](#) [get]
Path to the file. Note this may not always be a path in the filesystem.

Properties inherited from [Umbrella2.IO.IBackingFile](#)

2.48.1 Detailed Description

A handle to a [FITS](#) File on the disk. Used to read/write data.

2.48.2 Constructor & Destructor Documentation

FitsFile()

```
Umbrella2.IO.FITS.FitsFile.FitsFile (
    string Path,
    bool OutputImage,
    MEFImageNumberGetter numberGetter,
    FitsFileBuilder Headers) [protected]
```

2.48.3 Member Function Documentation

Close()

```
virtual void Umbrella2.IO.FITS.FitsFile.Close () [virtual]
```

Disposes of all handles and large in-memory resources.

Reimplemented in [Umbrella2.IO.FITS.NSStreamFitsFile](#).

DefaultGetter()

```
static int Umbrella2.IO.FITS.FitsFile.DefaultGetter (
    int ExtensionNumber,
    HeaderTable Header) [static], [package]
```

GetDataView()

```
IntPtr Umbrella2.IO.FITS.FitsFile.GetDataView (
    int Dataset,
    int DSetPosition,
    int Length) [package]
```

Memory maps image data.

Parameters

<i>Dataset</i>	Image number.
<i>DSetPosition</i>	Position in the data array at which the view should start.
<i>Length</i>	Length of the area viewed.

Returns

Pointer to the memory mapped view of the data.

GetView()

```
unsafe IntPtr Umbrella2.IO.FITS.FitsFile.GetView (
    int Position,
    int Length) [abstract], [package]
```

Memory-maps an area in the file.

Parameters

<i>Position</i>	Position in the file where the view should start.
<i>Length</i>	Length of the mapped file view.

Returns

Pointer to the memory mapped view.

MEFImageNumberGetter()

```
delegate int Umbrella2.IO.FITS.FitsFile.MEFImageNumberGetter (
    int ExtensionNumber,
    HeaderTable Header)
```

ReleaseHandle()

```
void Umbrella2.IO.FITS.FitsFile.ReleaseHandle () [abstract], [package]
```

Releases the file handle. Writing may not occur after the release. Reading reopens the handle.

ReleaseResources()

```
void Umbrella2.IO.FITS.FitsFile.ReleaseResources ()
```

Calls [ReleaseHandle](#).

Implements [Umbrella2.IO.IBackingFile](#).

ReleaseView()

```
void Umbrella2.IO.FITS.FitsFile.ReleaseView (
    IntPtr View) [abstract], [package]
```

Releases the memory mapped file view (and associated resources).

Parameters

<i>View</i>	Pointer to the memory mapped file view.
-------------	---

2.48.4 Member Data Documentation**ExtensionDataPointers**

```
readonly List<int> Umbrella2.IO.FITS.FitsFile.ExtensionDataPointers [protected]
```

MEFDataPointers

```
readonly Dictionary<int, int> Umbrella2.IO.FITS.FitsFile.MEFDataPointers [protected]
```

MEFHeaderTable

```
readonly Dictionary<int, HeaderTable> Umbrella2.IO.FITS.FitsFile.MEFHeaderTable
```

OutputFile

```
readonly bool Umbrella2.IO.FITS.FitsFile.OutputFile [protected]
```

Path

```
readonly string Umbrella2.IO.FITS.FitsFile.Path
```

PrimaryDataPointer

```
int Umbrella2.IO.FITS.FitsFile.PrimaryDataPointer [protected]
```

PrimaryTable

```
readonly HeaderTable Umbrella2.IO.FITS.FitsFile.PrimaryTable
```

2.48.5 Property Documentation

PathString

```
string Umbrella2.IO.FITS.FitsFile.PathString [get]
```

Path to the file. Note this may not always be a path in the filesystem.

The backing file may be on a network, so the path may be an URL, or the file may be inside an archive, so parsing this path may not be possible all the time. Nonetheless, it is expected that in most cases, this path will be a filesystem path.

Implements [Umbrella2.IO.IBackingFile](#).

2.49 Umbrella2.IO.FITS.FitsFileBuilder Class Reference

Package Attributes

- List< [MetadataRecord](#) > [PrimaryHeader](#)
- HeaderTable [PrimaryTable](#)
- int [PrimaryDataPointer](#)
- List< List< [MetadataRecord](#) > > [ExtensionHeaders](#)
- List< int > [ExtensionDataPointers](#)
- Dictionary< int, List< [MetadataRecord](#) > > [MEFImagesHeaders](#)
- Dictionary< int, HeaderTable > [MEFHeaderTable](#)
- Dictionary< int, int > [MEFDataPointers](#)

2.49.1 Member Data Documentation

ExtensionDataPointers

List<int> Umbrella2.IO.FITS.FitsFileBuilder.ExtensionDataPointers [package]

ExtensionHeaders

List<List<MetadataRecord> > Umbrella2.IO.FITS.FitsFileBuilder.ExtensionHeaders [package]

MEFDataPointers

Dictionary<int, int> Umbrella2.IO.FITS.FitsFileBuilder.MEFDataPointers [package]

MEFHeaderTable

Dictionary<int, HeaderTable> Umbrella2.IO.FITS.FitsFileBuilder.MEFHeaderTable [package]

MEFImagesHeaders

Dictionary<int, List<MetadataRecord> > Umbrella2.IO.FITS.FitsFileBuilder.MEFImagesHeaders [package]

PrimaryDataPointer

int Umbrella2.IO.FITS.FitsFileBuilder.PrimaryDataPointer [package]

PrimaryHeader

List<MetadataRecord> Umbrella2.IO.FITS.FitsFileBuilder.PrimaryHeader [package]

PrimaryTable

HeaderTable Umbrella2.IO.FITS.FitsFileBuilder.PrimaryTable [package]

2.50 Umbrella2.IO.FITS.FitsFileException Class Reference

Exceptions thrown from attempting to open or create a [FITS](#) file. This exception is raised only for issues with the file structure, that appear when trying to parse the on-disk record data into the in-memory hashmap and the pointers to the primary and extension data arrays and not for exceptions encountered while interpreting the image records (which are raised through [FitsImageException](#)).

Public Member Functions

- [FitsFileException](#) (string submessage, string filePath, long posBegin, long posEnd)
Initializes a new instance of the T:Umbrella2.IO.FITS.FitsFileException class.
- [FitsFileException](#) (string submessage, string filePath, long posBegin, long posEnd, [IFitsParsingError](#) innerError)
Initializes a new instance of the T:Umbrella2.IO.FITS.FitsFileException class.
- [FitsFileException](#) (string submessage, string filePath, long posBegin, long posEnd, Exception innerException)
Initializes a new instance of the T:Umbrella2.IO.FITS.FitsFileException class.

Static Protected Member Functions

- static string [ComputeMessage](#) (string submessage, string filePath, long posBegin, long posEnd)
Computes the error message from the provided error message and the path to the [FITS](#) file.

Properties

- string [FilePath](#) [get, set]
Path to the [FITS](#) file that raised the exception. Note that it may be null.
- long [StartPosition](#) [get, protected set]
Position in the file before the throwing code. Negative values mean not applicable (-1) or unknown position (-2).
- long [EndPosition](#) [get, protected set]
Current position in the file (after reading the throwing data). Negative values mean not applicable (-1) or unknown position (-2).
- [IFitsParsingError InnerError](#) [get, protected set]
Error raised by the parsing code. Note that it may be null.

2.50.1 Detailed Description

Exceptions thrown from attempting to open or create a [FITS](#) file. This exception is raised only for issues with the file structure, that appear when trying to parse the on-disk record data into the in-memory hashmap and the pointers to the primary and extension data arrays and not for exceptions encountered while interpreting the image records (which are raised through [FitsImageException](#)).

2.50.2 Constructor & Destructor Documentation

[FitsFileException\(\)](#) [1/3]

```
Umbrella2.IO.FITS.FitsFileException.FitsFileException (
    string submessage,
    string filePath,
    long posBegin,
    long posEnd)
```

Initializes a new instance of the T:Umbrella2.IO.FITS.FitsFileException class.

Parameters

<i>submessage</i>	Reason for the failure.
<i>filePath</i>	Path to the FITS file that raised the exception. Negative values mean not applicable (-1) or unknown position (-2).
<i>posBegin</i>	Position in the file before the throwing code. Negative values mean not applicable (-1) or unknown position (-2).
<i>posEnd</i>	Current position in the file (after reading the throwing data).

FitsFileException() [2/3]

```
Umbrella2.IO.FITS.FitsFileException.FitsFileException (
    string submessage,
    string filePath,
    long posBegin,
    long posEnd,
    IFitsParsingError innerError)
```

Initializes a new instance of the T:Umbrella2.IO.FITS.FitsFileException class.

Parameters

<i>submessage</i>	Explanation for the failure, in addition to the IFitsParsingError provided.
<i>filePath</i>	Path to the FITS file that raised the exception.
<i>posBegin</i>	Position in the file before the throwing code. Negative values mean not applicable (-1) or unknown position (-2).
<i>posEnd</i>	Current position in the file (after reading the throwing data). Negative values mean not applicable (-1) or unknown position (-2).
<i>innerError</i>	Exception raised by the called FITS parsing code.

FitsFileException() [3/3]

```
Umbrella2.IO.FITS.FitsFileException.FitsFileException (
    string submessage,
    string filePath,
    long posBegin,
    long posEnd,
    Exception innerException)
```

Initializes a new instance of the T:Umbrella2.IO.FITS.FitsFileException class.

Parameters

<i>submessage</i>	Explanation for the failure, in addition to the Exception provided.
<i>filePath</i>	Path to the FITS file that raised the exception.
<i>posBegin</i>	Position in the file before the throwing code. Negative values mean not applicable (-1) or unknown position (-2).
<i>posEnd</i>	Current position in the file (after reading the throwing data). Negative values mean not applicable (-1) or unknown position (-2).
<i>innerException</i>	Exception encountered while parsing the file data.

2.50.3 Member Function Documentation**ComputeMessage()**

```
static string Umbrella2.IO.FITS.FitsFileException.ComputeMessage (
    string submessage,
    string filePath,
    long posBegin,
    long posEnd) [static], [protected]
```

Computes the error message from the provided error message and the path to the [FITS](#) file.

Parameters

<i>submessage</i>	Explanation for the failure, in addition to the IFitsParsingError provided.
<i>filePath</i>	Path to the FITS file that raised the exception.

Returns

An error string to pass to the base constructor.

2.50.4 Property Documentation**EndPosition**

```
long Umbrella2.IO.FITS.FitsFileException.EndPosition [get], [protected set]
```

Current position in the file (after reading the throwing data). Negative values mean not applicable (-1) or unknown position (-2).

FilePath

```
string Umbrella2.IO.FITS.FitsFileException.FilePath [get], [set]
```

Path to the [FITS](#) file that raised the exception. Note that it may be null.

InnerError

```
IFitsParsingError Umbrella2.IO.FITS.FitsFileException.InnerError [get], [protected set]
```

Error raised by the parsing code. Note that it may be null.

StartPosition

```
long Umbrella2.IO.FITS.FitsFileException.StartPosition [get], [protected set]
```

[Position](#) in the file before the throwing code. Negative values mean not applicable (-1) or unknown position (-2).

2.51 Umbrella2.IO.FITS.FitsImage Class Reference

Class representing a [FITS](#) image from a [FITS](#) file.

Public Types

- enum [WcsHandling](#) { [DoNotParse](#) , [Optional](#) , [Mandatory](#) }
Specifies how [WCS](#) should be handled.

Public Member Functions

- [FitsImage](#) ([FitsFile](#) File, int Number=0, bool SkipWCS=false)
Retrieves an image from a [FITS](#) file.
- [FitsImage](#) ([FitsFile](#) File, int Number, [WcsHandling](#) WCS)
Retrieves an image from a [FITS](#) file.
- override void [CheckMarginsAndThrow](#) (Rectangle Area)
Checks whether the area of interest is within the boundaries of the image (see [IsInBounds\(Rectangle\)](#)) and throws if not.
- override bool [IsInBounds](#) (Rectangle Area)
Checks whether the area of interest is within the boundaries.
- override [ImageData LockData](#) (Rectangle Area, bool FillZero, bool RO=true)
Locks and returns the data of an image. Can be used for reading and writing.
- override [ImageData SwitchLockData](#) ([ImageData](#) Data, int NewX, int NewY, bool FillZero, bool RO=true)
Replaces the data view with another at different coordinates, flushing any writable data. Same as [ExitLock](#) followed by [LockData](#), however does not require a new data buffer allocation.
- override void [ExitLock](#) ([ImageData](#) Data)
Exits the lock on a region of image, flushing any writable data.
- override Guid [RawLockImage](#) (bool RO, out IntPtr Pointer, out bool LittleEndian, out int BitsPerPixel)
Locks and returns the data of an image in raw format.
- override void [ExitRawLock](#) (Guid Token, IntPtr Pointer)
Exits a raw lock on the image.
- [FICHV CopyHeader](#) ()
Creates a deep copy of the image's shallow header ([FICHV](#) defined headers).

Public Member Functions inherited from [Umbrella2.IO.Image](#)

- Dictionary< Type, [ImageProperties](#) > [GetAllProperties](#) ()
Returns all associated image properties.
- [ICHV GetICHV](#) ()
Gets the [Image](#)'s headers.
- T [GetProperty](#)< T > ()
Fetches the image properties of given type for the image. Caches the instance.
- bool [TryFetchProperty](#)< T > (out T Value)
Tries to fetch the image properties of the given type from the cache. Does not attempt to create a new instance if the properties are not found.
- void [CheckMarginsAndThrow](#) (Rectangle Area)
Checks whether the area of interest is within the boundaries of the image (see [IsInBounds\(Rectangle\)](#)) and throws if not.
- bool [IsInBounds](#) (Rectangle Area)
Checks whether the area of interest is within the boundaries.
- [ImageData LockData](#) (Rectangle Area, bool FillZero, bool RO=true)
Locks and returns the data of an image. Can be used for reading and writing.
- [ImageData SwitchLockData](#) ([ImageData](#) Data, int NewX, int NewY, bool FillZero, bool RO=true)
Replaces the data view with another at different coordinates, flushing any writable data. Same as [ExitLock](#) followed by [LockData](#), however does not require a new data buffer allocation.
- void [ExitLock](#) ([ImageData](#) Data)
Exits the lock on a region of image, flushing any writable data.
- Guid [RawLockImage](#) (bool RO, out IntPtr Pointer, out bool LittleEndian, out int BitsPerPixel)
Locks and returns the data of an image in raw format.
- void [ExitRawLock](#) (Guid Token, IntPtr Pointer)
Exits a raw lock on the image.

Static Public Member Functions

- static [FICHV ParseHeaderTable](#) (int [ImageNumber](#), HeaderTable [Header](#), string Path, [WcsHandling](#) Wcs)
Parses a [FICHV](#) out of the raw header table.

Public Attributes

- readonly [FitsFile](#) [File](#)
File containing the image.

Public Attributes inherited from [Umbrella2.IO.Image](#)

- readonly uint [Width](#)
- readonly uint [Height](#)
- readonly int [ImageNumber](#)
The number of the image in a multi-image file. Is 0 for the primary image; begins at 1 for extensions and sub-frames.
- readonly [IWCSProjection](#) [Transform](#)
World Coordinate System Transformation. Depending on the image opening policy and missing metadata, may be null.
- readonly [ImageTiming](#) [Time](#)
Timing information of the image. Depending on the image opening policy and missing metadata, may be null.
- readonly HeaderTable [Header](#)
[FITS Image](#) Headers.

Protected Member Functions

- [FitsImage](#) (int Number, [IWCSProjection](#) Projection, HeaderTable [Header](#), uint [Width](#), uint [Height](#))
Pass-through constructor to [Image](#).
- [FitsImage](#) ([FICHV](#) data)
Expansion of [FICHV](#) to pass-through constructor.

Protected Member Functions inherited from [Umbrella2.IO.Image](#)

- [Image](#) (int [ImageNumber](#), [IWCSProjection](#) [Transform](#), HeaderTable [Header](#), uint [Width](#), uint [Height](#))
- [Image](#) ([ICHV](#) Headers)
Creates a new instance from a set of headers.
- [Image](#) ([ICHV](#) Headers, Dictionary< Type, [ImageProperties](#) > Properties)
Creates a new instance from a set of headers and properties.

Protected Attributes

- readonly bool [RAFirst](#)
True if Right ascension is AXIS1. False otherwise.

Protected Attributes inherited from [Umbrella2.IO.Image](#)

- readonly Dictionary< Type, [ImageProperties](#) > [PropertiesDictionary](#)
Extra [Image](#) Properties.

Properties

- override [IBackingFile BackingFile](#) [get]

Properties inherited from [Umbrella2.IO.Image](#)

- [IBackingFile BackingFile](#) [get]
Gets the file backing the current image.

Private Member Functions

- void [ReadData](#) ([ImageData](#) imageData)
Reads data from file.
- void [WriteData](#) ([ImageData](#) data)
Writes data to the file.
- [Tuple](#)< int, int > [GetPositionInFile](#) ([Rectangle](#) location)
Returns the position of relevant image data in file.

Static Private Member Functions

- static [Tuple](#)< [DataReader](#), [DataWriter](#) > [GetRW](#) (int bitpix)
Selects the reading/writing functions for a given BITPIX value.
- static double [ReadHeaderFloat](#) (string keyName, double default, [HeaderTable](#) header)
Reads a floating point value from the headers if it exists. Otherwise returns the specified default.
- static bool [TryReadHeader](#)< T > ([HeaderTable](#) header, string key, out T value)
Tries to read a value from the header.
- static [WCSTable](#) [ParseWCS](#) ([HeaderTable](#) header)
Parses the WCS records into a WCSTable.
- static [WCSTable](#) [TryParseWCS](#) ([HeaderTable](#) header)
Parses the WCS records into a WCSTable.
- static bool [CheckUnit](#) ([HeaderTable](#) header, string key)
Quick helper for checking that the reference units are in degrees.

Private Attributes

- readonly [RWLockArea](#) imageLock
Readers-Writers lock for portions of the image.
- readonly [DataReader](#) reader
Method to read/parse memory to double[.,].
- readonly [DataWriter](#) writer
Method to write/serialize from double[.,] to memory.
- readonly byte bytesPerPixel
The number of bytes for each pixel. Abs(BITPIX)/8.

Static Private Attributes

- const int [MaxSize](#) = 1000000
Sanity check for image Width and Height.

2.51.1 Detailed Description

Class representing a [FITS](#) image from a [FITS](#) file.

2.51.2 Member Enumeration Documentation

WcsHandling

enum [Umbrella2.IO.FITS.FitsImage.WcsHandling](#)

Specifies how [WCS](#) should be handled.

Enumerator

DoNotParse	Do not attempt to parse WCS .
Optional	WCS is optional, attach it if the parsing succeeds.
Mandatory	WCS parsing is mandatory; throw if the WCS is incorrect.

2.51.3 Constructor & Destructor Documentation

FitsImage() [1/4]

```
Umbrella2.IO.FITS.FitsImage.FitsImage (  
    int Number,  
    IWCSProjection Projection,  
    HeaderTable Header,  
    uint Width,  
    uint Height) [protected]
```

Pass-through constructor to [Image](#).

FitsImage() [2/4]

```
Umbrella2.IO.FITS.FitsImage.FitsImage (  
    FICHV data) [protected]
```

Expansion of [FICHV](#) to pass-through constructor.

FitsImage() [3/4]

```
Umbrella2.IO.FITS.FitsImage.FitsImage (  
    FitsFile File,  
    int Number = 0,  
    bool SkipWCS = false)
```

Retrieves an image from a [FITS](#) file.

Parameters

<i>File</i>	Input file.
<i>Number</i>	Image number in multi-image (MEF) FITS files.
<i>SkipWCS</i>	Whether to parse the WCS headers.

FitsImage() [4/4]

```
Umbrella2.IO.FITS.FitsImage.FitsImage (
    FitsFile File,
    int Number,
    WcsHandling WCS)
```

Retrieves an image from a [FITS](#) file.

Parameters

<i>File</i>	Input file.
<i>Number</i>	Image number in multi-image (MEF) FITS files. Zero is reserved for primary data array (SEF files). MEF extensions are numbered starting from 1.
<i>WCS</i>	WCS handling strategy.

2.51.4 Member Function Documentation**CheckMarginsAndThrow()**

```
override void Umbrella2.IO.FITS.FitsImage.CheckMarginsAndThrow (
    Rectangle Area)
```

Checks whether the area of interest is within the boundaries of the image (see [IsInBounds\(Rectangle\)](#)) and throws if not.

Parameters

<i>Area</i>	Area of interest.
-------------	-------------------

CheckUnit()

```
static bool Umbrella2.IO.FITS.FitsImage.CheckUnit (
    HeaderTable Header,
    string Key) [static], [private]
```

Quick helper for checking that the reference units are in degrees.

CopyHeader()

```
FICHV Umbrella2.IO.FITS.FitsImage.CopyHeader ()
```

Creates a deep copy of the image's shallow header ([FICHV](#) defined headers).

ExitLock()

```
override void Umbrella2.IO.FITS.FitsImage.ExitLock (  
    ImageData Data)
```

Exits the lock on a region of image, flushing any writable data.

Parameters

<i>Data</i>	The data container.
-------------	---------------------

ExitRawLock()

```
override void Umbrella2.IO.FITS.FitsImage.ExitRawLock (
    Guid Token,
    IntPtr Pointer)
```

Exits a raw lock on the image.

Parameters

<i>Token</i>	Lock token.
<i>Pointer</i>	Pointer to raw image data.

GetPositionInFile()

```
Tuple< int, int > Umbrella2.IO.FITS.FitsImage.GetPositionInFile (
    Rectangle Location) [private]
```

Returns the position of relevant image data in file.

Parameters

<i>Location</i>	Area of interest.
-----------------	-------------------

Returns

A tuple containing the pointer in file to the start of the data and its length.

GetRW()

```
static Tuple< DataReader, DataWriter > Umbrella2.IO.FITS.FitsImage.GetRW (
    int BitPix) [static], [private]
```

Selects the reading/writing functions for a given BITPIX value.

Parameters

<i>BitPix</i>	BITPIX value.
---------------	---------------

Returns

Delegates to conversion functions.

IsInBounds()

```
override bool Umbrella2.IO.FITS.FitsImage.IsInBounds (
    Rectangle Area)
```

Checks whether the area of interest is within the boundaries.

Returns

`true`, if the *Area* is fully contained inside the image, `false` otherwise.

Parameters

<i>Area</i>	Area of interest.
-------------	-------------------

LockData()

```
override ImageData Umbrella2.IO.FITS.FitsImage.LockData (
    Rectangle Area,
    bool FillZero,
    bool RO = true)
```

Locks and returns the data of an image. Can be used for reading and writing.

Parameters

<i>Area</i>	Area of interest in the image.
<i>FillZero</i>	True for padding out of image margins with zero. Must be false for write access.
<i>RO</i>	Whether the data is read-only.

Returns

An [ImageData](#) container.

ParseHeaderTable()

```
static FICHV Umbrella2.IO.FITS.FitsImage.ParseHeaderTable (
    int ImageNumber,
    HeaderTable Header,
    string Path,
    WcsHandling Wcs) [static]
```

Parses a [FICHV](#) out of the raw header table.

Returns

The [FICHV](#) header table.

Parameters

<i>ImageNumber</i>	Image 's number in the file.
<i>Header</i>	Image 's raw header.
<i>Path</i>	Path of the FITS file, for error reporting purposes.
<i>Wcs</i>	WCS handling options.

ParseWCS()

```
static WCSViaProjection Umbrella2.IO.FITS.FitsImage.ParseWCS (
    HeaderTable Header) [static], [private]
```

Parses the [WCS](#) records into a [WCSViaProjection](#).

Parameters

<i>Header</i>	Image header.
---------------	---------------

RawLockImage()

```
override Guid Umbrella2.IO.FITS.FitsImage.RawLockImage (
    bool RO,
    out IntPtr Pointer,
    out bool LittleEndian,
    out int BitsPerPixel)
```

Locks and returns the data of an image in raw format.

Returns

The lock token.

Parameters

<i>RO</i>	If set to <code>true</code> , the lock is acquired for reading.
<i>Pointer</i>	Pointer to raw image data.
<i>LittleEndian</i>	If set to <code>true</code> , the data is little-endian. The data is big-endian otherwise.
<i>BitsPerPixel</i>	The number of bits per pixel. Positive if integer valued, negative if IEEE 754.

ReadData()

```
void Umbrella2.IO.FITS.FitsImage.ReadData (
    ImageData imageData) [private]
```

Reads data from file.

Parameters

<i>imData</i>	Data container.
---------------	-----------------

ReadHeaderFloat()

```
static double Umbrella2.IO.FITS.FitsImage.ReadHeaderFloat (
    string KeyName,
    double Default,
    HeaderTable Header) [static], [private]
```

Reads a floating point value from the headers if it exists. Otherwise returns the specified default.

Parameters

<i>KeyName</i>	Header name.
<i>Default</i>	Default value.
<i>Header</i>	Header to read from.

SwitchLockData()

```

override ImageData Umbrella2.IO.FITS.FitsImage.SwitchLockData (
    ImageData Data,
    int NewX,
    int NewY,
    bool FillZero,
    bool RO = true)

```

Replaces the data view with another at different coordinates, flushing any writable data. Same as ExitLock followed by LockData, however does not require a new data buffer allocation.

Parameters

<i>Data</i>	Previous data.
<i>NewX</i>	New X coordinate.
<i>NewY</i>	New Y coordinate.
<i>FillZero</i>	True for padding out of image margins with zero. Must be false for write access.
<i>RO</i>	Whether the data is read-only.

Returns

An [ImageData](#) container.

TryParseWCS()

```

static WCSViaProjection Umbrella2.IO.FITS.FitsImage.TryParseWCS (
    HeaderTable Header) [static], [private]

```

Parses the [WCS](#) records into a WCSViaProjection.

Parameters

<i>Header</i>	Image header.
---------------	-------------------------------

TryReadHeader< T >()

```

static bool Umbrella2.IO.FITS.FitsImage.TryReadHeader< T > (
    HeaderTable Header,
    string Key,
    out T Value) [static], [private]

```

Tries to read a value from the header.

Returns

`true`, if the value was found and could be parsed, `false` otherwise.

Parameters

<i>Header</i>	FITS Header.
<i>Key</i>	Record name.
<i>Value</i>	Output record value.

Template Parameters

<i>T</i>	The type of the value expected.
----------	---------------------------------

WriteData()

```
void Umbrella2.IO.FITS.FitsImage.WriteData (
    ImageData Data) [private]
```

Writes data to the file.

Parameters

<i>Data</i>	Data to be written.
-------------	---------------------

2.51.5 Member Data Documentation**BytesPerPixel**

```
readonly byte Umbrella2.IO.FITS.FitsImage.BytesPerPixel [private]
```

The number of bytes for each pixel. Abs(BITPIX)/8.

File

```
readonly FitsFile Umbrella2.IO.FITS.FitsImage.File
```

File containing the image.

ImageLock

```
readonly RWLockArea Umbrella2.IO.FITS.FitsImage.ImageLock [private]
```

Readers-Writers lock for portions of the image.

MaxSize

```
const int Umbrella2.IO.FITS.FitsImage.MaxSize = 1000000 [static], [private]
```

Sanity check for image Width and Height.

RAFirst

```
readonly bool Umbrella2.IO.FITS.FitsImage.RAFirst [protected]
```

True if Right ascension is AXIS1. False otherwise.

Reader

```
readonly DataReader Umbrella2.IO.FITS.FitsImage.Reader [private]
```

Method to read/parse memory to double[,].

Writer

```
readonly DataWriter Umbrella2.IO.FITS.FitsImage.Writer [private]
```

Method to write/serialize from double[,] to memory.

2.51.6 Property Documentation

BackingFile

```
override IBackingFile Umbrella2.IO.FITS.FitsImage.BackingFile [get]
```

2.52 Umbrella2.IO.FITS.FitsImageException Class Reference

Exception raised when trying to parse image data from a [FITS](#) file. This exception is raised only for image records; if the file itself is broken, the [FitsFileException](#) is raised instead.

Public Member Functions

- [FitsImageException](#) (string submessage, string filePath, int imageNumber, [IFitsParsingError](#) innerError)
Initializes a new instance of the T:Umbrella2.IO.FITS.FitsImageException class.
- [FitsImageException](#) (string submessage, string filePath, int imageNumber, Exception innerException)
Initializes a new instance of the T:Umbrella2.IO.FITS.FitsImageException class.

Static Protected Member Functions

- static string [ComputeMessage](#) (string submessage, string filePath, int imageNumber)
Computes the error message from the provided error message and the path to the [FITS](#) file.

Properties

- string [FilePath](#) [get, protected set]
Path to the *FITS* file that raised the exception. Note that it may be null.
- int [ImageNumber](#) [get, protected set]
Number of the image; with 0 for the primary data array and positive numbers for extension arrays.
- [IFitsParsingError InnerError](#) [get, protected set]
Error raised by the parsing code. Note that it may be null.

2.52.1 Detailed Description

Exception raised when trying to parse image data from a [FITS](#) file. This exception is raised only for image records; if the file itself is broken, the [FitsFileException](#) is raised instead.

2.52.2 Constructor & Destructor Documentation

FitsImageException() [1/2]

```
Umbrella2.IO.FITS.FitsImageException.FitsImageException (
    string submessage,
    string filePath,
    int imageNumber,
    IFitsParsingError innerError)
```

Initializes a new instance of the T:Umbrella2.IO.FITS.FitsImageException class.

Parameters

<i>submessage</i>	Explanation for the failure, in addition to the IFitsParsingError provided.
<i>filePath</i>	Path to the FITS file that raised the exception.
<i>imageNumber</i>	Number of the image; with 0 for the primary data array and positive numbers for extension arrays.
<i>innerError</i>	Exception raised by the called FITS parsing code.

FitsImageException() [2/2]

```
Umbrella2.IO.FITS.FitsImageException.FitsImageException (
    string submessage,
    string filePath,
    int imageNumber,
    Exception innerException)
```

Initializes a new instance of the T:Umbrella2.IO.FITS.FitsImageException class.

Parameters

<i>submessage</i>	Explanation for the failure, in addition to the Exception provided.
<i>filePath</i>	Path to the FITS file that raised the exception.
<i>imageNumber</i>	Number of the image; with 0 for the primary data array and positive numbers for extension arrays.
<i>innerException</i>	Exception encountered while parsing the file data.

2.52.3 Member Function Documentation

ComputeMessage()

```
static string Umbrella2.IO.FITS.FitsImageException.ComputeMessage (
    string submessage,
    string filePath,
    int imageNumber) [static], [protected]
```

Computes the error message from the provided error message and the path to the [FITS](#) file.

Parameters

<i>submessage</i>	Explanation for the failure, in addition to the IFitsParsingError provided.
<i>filePath</i>	Path to the FITS file that raised the exception.
<i>imageNumber</i>	Number of the image; see ImageNumber for details.

Returns

An error string to pass to the base constructor.

2.52.4 Property Documentation

FilePath

```
string Umbrella2.IO.FITS.FitsImageException.FilePath [get], [protected set]
```

Path to the [FITS](#) file that raised the exception. Note that it may be null.

ImageNumber

```
int Umbrella2.IO.FITS.FitsImageException.ImageNumber [get], [protected set]
```

Number of the image; with 0 for the primary data array and positive numbers for extension arrays.

InnerError

```
IFitsParsingError Umbrella2.IO.FITS.FitsImageException.InnerError [get], [protected set]
```

Error raised by the parsing code. Note that it may be null.

2.53 Umbrella2.IO.FITS.FITSMetadataRecord Class Reference

Public Member Functions

- [FITSMetadataRecord](#) (string [Name](#), string [Data](#))
- override bool [TryGetIntegerValue](#) (out long [Value](#))
- override bool [TryGetString](#) (out string [FixedString](#))
- override bool [TryGetBoolean](#) (out bool [State](#))
- override bool [TryGetDouble](#) (out double [Value](#))

Public Member Functions inherited from Umbrella2.IO.MetadataRecord

- [MetadataRecord](#) (string [Name](#), string [Data](#))
- bool [TryGetIntegerValue](#) (out long [Value](#))
Attempts to parse the record as an integer (without throwing exceptions).
- bool [TryGetString](#) (out string [FixedString](#))
Attempts to parse the record as a fixed string.
- bool [TryGetBoolean](#) (out bool [State](#))
Attempts to parse the record as a boolean (without throwing exceptions).
- bool [TryGet< T >](#) (out T [Value](#))
Generic, dynamically dispatched getter function. Dispatches into one of the other Try functions based on the type of the Value . Throws on the use of an incorrect type.
- bool [TryGetDouble](#) (out double [Value](#))
Attempts to parse the record as a floating point value (without throwing exceptions).
- override string [ToString](#) ()

Protected Member Functions

- override long [GetIntegerValue](#) ()

Protected Member Functions inherited from Umbrella2.IO.MetadataRecord

- long [GetIntegerValue](#) ()
Assumes the record holds an integer and parses it.

Package Functions

- byte[] [ToRawRecord](#) ()

Static Package Functions

- static byte[] [ToRawRecord](#) ([MetadataRecord](#) record)
Formats an [MetadataRecord](#) as an 80-byte field ready to be written to disk.

Properties

- override string [AsString](#) [get]
Parses the value as a string from the encoding of a [FITS](#) fixed string.
- override bool [Bool](#) [get]
Parses the value as a bool.
- override double [FloatingPoint](#) [get]
Parses the value as a double.

Properties inherited from [Umbrella2.IO.MetadataRecord](#)

- virtual long [Long](#) [get]
Parses the value as a long.
- virtual int [Int](#) [get]
Parses the value as an int.
- virtual short [Short](#) [get]
Parses the value as a short.
- virtual sbyte [SByte](#) [get]
Parses the value as an sbyte.
- virtual byte [Byte](#) [get]
Parses the value as a byte.
- string [AsString](#) [get]
Parses the value as a string from the encoding of a [FITS](#) fixed string.
- bool [Bool](#) [get]
Parses the value as a bool.
- double [FloatingPoint](#) [get]
Parses the value as a double.

Private Member Functions

- string [GetValueTypedValue](#) ()
Reads the data string as a [FITS](#) value-typed string.
- bool [TryGetValueTypedValue](#) (out string VTValue)
Reads the data string as a [FITS](#) value-typed string.

Additional Inherited Members

Public Attributes inherited from [Umbrella2.IO.MetadataRecord](#)

- readonly string [Name](#)
- readonly string [DataString](#)

2.53.1 Constructor & Destructor Documentation

FITSMetadataRecord()

```
Umbrella2.IO.FITS.FITSMetadataRecord.FITSMetadataRecord (
    string Name,
    string Data)
```

2.53.2 Member Function Documentation

GetIntegerValue()

```
override long Umbrella2.IO.FITS.FITSMetadataRecord.GetIntegerValue () [protected]
```

GetValueTypedValue()

```
string Umbrella2.IO.FITS.FITSMetadataRecord.GetValueTypedValue () [private]
```

Reads the data string as a [FITS](#) value-typed string.

Returns

The value encoded in the `DataString`.

ToRawRecord() [1/2]

```
byte[] Umbrella2.IO.FITS.FITSMetadataRecord.ToRawRecord () [package]
```

ToRawRecord() [2/2]

```
static byte[] Umbrella2.IO.FITS.FITSMetadataRecord.ToRawRecord (  
    MetadataRecord record) [static], [package]
```

[Formats](#) an [MetadataRecord](#) as an 80-byte field ready to be written to disk.

Parameters

<i>record</i>	Instance to be formatted.
---------------	---------------------------

Returns

A byte array containing the binary representation of the record.

TryGetBoolean()

```
override bool Umbrella2.IO.FITS.FITSMetadataRecord.TryGetBoolean (  
    out bool State)
```

TryGetDouble()

```
override bool Umbrella2.IO.FITS.FITSMetadataRecord.TryGetDouble (  
    out double Value)
```

TryGetIntegerValue()

```
override bool Umbrella2.IO.FITS.FITSMetadataRecord.TryGetIntegerValue (  
    out long Value)
```

TryGetString()

```
override bool Umbrella2.IO.FITS.FITSMetadataRecord.TryGetString (  
    out string FixedString)
```

TryGetValueTypedValue()

```
bool Umbrella2.IO.FITS.FITSMetadataRecord.TryGetValueTypedValue (  
    out string VTValue) [private]
```

Reads the data string as a [FITS](#) value-typed string.

Parameters

<i>VTValue</i>	The value encoded in the DataString.
----------------	--------------------------------------

Returns

`true` if the record has a value-typed value, `false` otherwise.

2.53.3 Property Documentation

AsString

```
override string Umbrella2.IO.FITS.FITSMetadataRecord.AsString [get]
```

Parses the value as a string from the encoding of a [FITS](#) fixed string.

Bool

```
override bool Umbrella2.IO.FITS.FITSMetadataRecord.Bool [get]
```

Parses the value as a bool.

FloatingPoint

```
override double Umbrella2.IO.FITS.FITSMetadataRecord.FloatingPoint [get]
```

Parses the value as a double.

2.54 Umbrella2.IO.FITS.FitsNotStandardException Class Reference

Exception thrown when the input [FITS](#) file (or headers provided to the [FITS](#) creation function) do not respect the [FITS](#) standard.

Public Member Functions

- [FitsNotStandardException](#) (string message)

Initializes a new instance of the `T:Umbrella2.IO.FITS.FitsNotStandardException` class.

Properties

- string [ProblemKeyword](#) [get]

Always null.

Properties inherited from [Umbrella2.IO.FITS.IFitsParsingError](#)

2.54.1 Detailed Description

Exception thrown when the input [FITS](#) file (or headers provided to the [FITS](#) creation function) do not respect the [FITS](#) standard.

2.54.2 Constructor & Destructor Documentation

FitsNotStandardException()

```
Umbrella2.IO.FITS.FitsNotStandardException.FitsNotStandardException (  
    string message)
```

Initializes a new instance of the T:Umbrella2.IO.FITS.FitsNotStandardException class.

Parameters

<code>message</code>	Reason as to how the standard is broken.
----------------------	--

2.54.3 Property Documentation

ProblemKeyword

```
string Umbrella2.IO.FITS.FitsNotStandardException.ProblemKeyword [get]
```

Always null.

Implements [Umbrella2.IO.FITS.IFitsParsingError](#).

2.55 Umbrella2.IO.FITS.FitsRecordException Class Reference

Represents an exception that occurs when parsing a [FITS](#) record.

Public Member Functions

- [FitsRecordException](#) (string submessage, [MetadataRecord](#) record)
Creates a new instance of the [FitsRecordException](#) class.
- [FitsRecordException](#) (string submessage, [MetadataRecord](#) record, Exception inner)
Creates a new instance of the [FitsRecordException](#) class.
- [FitsRecordException](#) (string submessage, string keyword)
Creates a new instance of the [FitsRecordException](#) class. This variant should be used when parsing failed so badly that no [MetadataRecord](#) could be extracted.
- [FitsRecordException](#) (string submessage, string keyword, Exception inner)
Creates a new instance of the [FitsRecordException](#) class. This variant should be used when parsing failed so badly that no [MetadataRecord](#) could be extracted.

Public Attributes

- readonly string [Keyword](#)
Keyword of the record that failed to parse.
- readonly [MetadataRecord](#) [Record](#)
The raw record from the [FITS](#) header.

Properties

- string [ProblemKeyword](#) [get]
Keyword which triggered this issue. May be null. Note this may not always point to the problem record, as previous records may have put the parsing code in a state where this specific keyword is not valid, although normally it would be fine.

Properties inherited from [Umbrella2.IO.FITS.IFitsParsingError](#)

2.55.1 Detailed Description

Represents an exception that occurs when parsing a [FITS](#) record.

2.55.2 Constructor & Destructor Documentation

FitsRecordException() [1/4]

```
Umbrella2.IO.FITS.FitsRecordException.FitsRecordException (
    string submessage,
    MetadataRecord record)
```

Creates a new instance of the [FitsRecordException](#) class.

Parameters

<i>submessage</i>	Reason for the exception.
<i>record</i>	Record that failed to parse.

FitsRecordException() [2/4]

```
Umbrella2.IO.FITS.FitsRecordException.FitsRecordException (
    string submessage,
    MetadataRecord record,
    Exception inner)
```

Creates a new instance of the [FitsRecordException](#) class.

Parameters

<i>submessage</i>	Reason for the exception.
<i>record</i>	Record that failed to parse.
<i>inner</i>	Exception encountered during parsing.

FitsRecordException() [3/4]

```
Umbrella2.IO.FITS.FitsRecordException.FitsRecordException (
    string submessage,
    string keyword)
```

Creates a new instance of the [FitsRecordException](#) class. This variant should be used when parsing failed so badly that no [MetadataRecord](#) could be extracted.

Parameters

<i>submessage</i>	Reason for the exception.
<i>keyword</i>	Keyword of the record that failed to parse.

FitsRecordException() [4/4]

```
Umbrella2.IO.FITS.FitsRecordException.FitsRecordException (
    string submessage,
    string keyword,
    Exception inner)
```

Creates a new instance of the [FitsRecordException](#) class. This variant should be used when parsing failed so badly that no [MetadataRecord](#) could be extracted.

Parameters

<i>submessage</i>	Reason for the exception.
<i>keyword</i>	Keyword of the record that failed to parse.
<i>inner</i>	Exception encountered during parsing.

2.55.3 Member Data Documentation**Keyword**

```
readonly string Umbrella2.IO.FITS.FitsRecordException.Keyword
```

Keyword of the record that failed to parse.

Record

```
readonly MetadataRecord Umbrella2.IO.FITS.FitsRecordException.Record
```

The raw record from the [FITS](#) header.

2.55.4 Property Documentation**ProblemKeyword**

```
string Umbrella2.IO.FITS.FitsRecordException.ProblemKeyword [get]
```

Keyword which triggered this issue. May be null. Note this may not always point to the problem record, as previous records may have put the parsing code in a state where this specific keyword is not valid, although normally it would be fine.

Implements [Umbrella2.IO.FITS.IFitsParsingError](#).

2.56 Umbrella2.Visualizer.WinForms.FitsView Class Reference

WinForms control to display a FITS image (or a portion of it).

Public Member Functions

- [FitsView](#) ()
- override void [Refresh](#) ()
- void [HighlightPixels](#) (IEnumerable< [PixelPoint](#) > Pixels)
- void [Reload](#) ()

Reloads image data and shows it.

Public Attributes

- [IFitsViewScaler](#) Scaler

Image scaling algorithm.

Protected Member Functions

- void [ResizeBitmap](#) ()
Resizes the [Data](#) bitmap to match the screen size.
- void [ShowBitmap](#) ()
Shows the [Data](#) bitmap through [pictureBox1](#).
- override void [Dispose](#) (bool disposing)

Clean up any resources being used.

Protected Attributes

- Point [TopLeft](#)
- Rectangle [Display](#)
- [ByteBitmap](#) Data
- System.Windows.Forms.PictureBox [pictureBox1](#)

FITS displayer control.

Properties

- [IO.Image](#) [Image](#) [get, set]
Image to be displayed on the control.
- Point [Center](#) [get, set]
The coordinates of the central point.

Private Member Functions

- void [ReadBitmap](#) ()
 - void [FitsView_Resize](#) (object sender, EventArgs e)
 - void [FitsView_Load](#) (object sender, EventArgs e)
 - void [InitializeComponent](#) ()
- Required method for Designer support - do not modify the contents of this method with the code editor.*

Private Attributes

- System.ComponentModel.IContainer [components](#) = null
Required designer variable.

Static Private Attributes

- static bool `OnMono` = `Type.GetType("Mono.Runtime") != null`

2.56.1 Detailed Description

WinForms control to display a FITS image (or a portion of it).

2.56.2 Constructor & Destructor Documentation

FitsView()

```
Umbrella2.Visualizer.WinForms.FitsView.FitsView ()
```

2.56.3 Member Function Documentation

Dispose()

```
override void Umbrella2.Visualizer.WinForms.FitsView.Dispose (  
    bool disposing) [protected]
```

Clean up any resources being used.

Parameters

<i>disposing</i>	true if managed resources should be disposed; otherwise, false.
------------------	---

FitsView_Load()

```
void Umbrella2.Visualizer.WinForms.FitsView.FitsView_Load (  
    object sender,  
    EventArgs e) [private]
```

FitsView_Resize()

```
void Umbrella2.Visualizer.WinForms.FitsView.FitsView_Resize (  
    object sender,  
    EventArgs e) [private]
```

HighlightPixels()

```
void Umbrella2.Visualizer.WinForms.FitsView.HighlightPixels (  
    IEnumerable< PixelPoint > pixels)
```

InitializeComponent()

```
void Umbrella2.Visualizer.WinForms.FitsView.InitializeComponent () [private]
```

Required method for Designer support - do not modify the contents of this method with the code editor.

ReadBitmap()

```
void Umbrella2.Visualizer.WinForms.FitsView.ReadBitmap () [private]
```

Refresh()

```
override void Umbrella2.Visualizer.WinForms.FitsView.Refresh ()
```

Reload()

```
void Umbrella2.Visualizer.WinForms.FitsView.Reload ()
```

Reloads image data and shows it.

ResizeBitmap()

```
void Umbrella2.Visualizer.WinForms.FitsView.ResizeBitmap () [protected]
```

Resizes the [Data](#) bitmap to match the screen size.

ShowBitmap()

```
void Umbrella2.Visualizer.WinForms.FitsView.ShowBitmap () [protected]
```

Shows the [Data](#) bitmap through [pictureBox1](#).

2.56.4 Member Data Documentation

components

```
System.ComponentModel.IContainer Umbrella2.Visualizer.WinForms.FitsView.components = null  
[private]
```

Required designer variable.

Data

```
ByteBitmap Umbrella2.Visualizer.WinForms.FitsView.Data [protected]
```

Display

`Rectangle Umbrella2.Visualizer.WinForms.FitsView.Display [protected]`

OnMono

`bool Umbrella2.Visualizer.WinForms.FitsView.OnMono = Type.GetType("Mono.Runtime") != null
[static], [private]`

pictureBox1

`System.Windows.Forms.PictureBox Umbrella2.Visualizer.WinForms.FitsView.pictureBox1 [protected]`

FITS displayer control.

Scaler

`IFitsViewScaler Umbrella2.Visualizer.WinForms.FitsView.Scaler`

Image scaling algorithm.

TopLeft

`Point Umbrella2.Visualizer.WinForms.FitsView.TopLeft [protected]`

2.56.5 Property Documentation

Center

`Point Umbrella2.Visualizer.WinForms.FitsView.Center [get], [set]`

The coordinates of the central point.

Image

`IO.Image Umbrella2.Visualizer.WinForms.FitsView.Image [get], [set]`

Image to be displayed on the control.

2.57 Umbrella2.IO.FITS.Formats.FPDataset Class Reference

Module for reading from and writing to floating-point [FITS](#) data arrays. Functions provide for converting memory-mapped file data to IEEE floating point.

Static Public Member Functions

- static unsafe void [Read32](#) (IntPtr Pointer, double[,] Data, int Hstart, int Hend, int Wstart, int Wend, int Stride)
- static unsafe void [Write32](#) (IntPtr Pointer, double[,] Data, int Stride)
- static unsafe void [Read64](#) (IntPtr Pointer, double[,] Data, int Hstart, int Hend, int Wstart, int Wend, int Stride)
- static unsafe void [Write64](#) (IntPtr Pointer, double[,] Data, int Stride)

2.57.1 Detailed Description

Module for reading from and writing to floating-point [FITS](#) data arrays. Functions provide for converting memory-mapped file data to IEEE floating point.

2.57.2 Member Function Documentation

Read32()

```
static unsafe void Umbrella2.IO.FITS.Formats.FPDataset.Read32 (
    IntPtr Pointer,
    double Data[],
    int Hstart,
    int Hend,
    int Wstart,
    int Wend,
    int Stride) [static]
```

Read64()

```
static unsafe void Umbrella2.IO.FITS.Formats.FPDataset.Read64 (
    IntPtr Pointer,
    double Data[],
    int Hstart,
    int Hend,
    int Wstart,
    int Wend,
    int Stride) [static]
```

Write32()

```
static unsafe void Umbrella2.IO.FITS.Formats.FPDataset.Write32 (
    IntPtr Pointer,
    double Data[],
    int Stride) [static]
```

Write64()

```
static unsafe void Umbrella2.IO.FITS.Formats.FPDataset.Write64 (
    IntPtr Pointer,
    double Data[],
    int Stride) [static]
```

2.58 Umbrella2.Algorithms.Misc.ConnectedComponentGraph< T >.GNode Class Reference

Package Attributes

- [T Object](#)
- [int Index](#)
- [List< GNode > ConnectedNodes](#)

2.58.1 Member Data Documentation

ConnectedNodes

`List<GNode> Umbrella2.Algorithms.Misc.ConnectedComponentGraph< T >.GNode.ConnectedNodes` [package]

Index

`int Umbrella2.Algorithms.Misc.ConnectedComponentGraph< T >.GNode.Index` [package]

Object

`T Umbrella2.Algorithms.Misc.ConnectedComponentGraph< T >.GNode.Object` [package]

2.59 Umbrella2.WCS.EquatorialDistance.GreatLine Struct Reference

Defines a spherical line segment / arc of a great circle.

Public Member Functions

- [GreatLine \(EquatorialPoint A, EquatorialPoint B\)](#)
Generates the great circle through the 2 given points.
- [EquatorialPoint GetPointOnLine \(double Distance\)](#)
Returns the point a given distance away (from B) on the great circle.

Static Public Member Functions

- static [EquatorialPoint operator+ \(GreatLine Vector, double Distance\)](#)
Provides great circle navigation. Equivalent of GetPointOnLine.
- static double [operator~ \(GreatLine Vector\)](#)
Returns the line length / spherical distance between the points on the sphere.

Package Attributes

- [Vector3D A](#)
- [Vector3D B](#)
- double [AlphaAngle](#)

2.59.1 Detailed Description

Defines a spherical line segment / arc of a great circle.

2.59.2 Constructor & Destructor Documentation

GreatLine()

```
Umbrella2.WCS.EquatorialDistance.GreatLine.GreatLine (
    EquatorialPoint A,
    EquatorialPoint B)
```

Generates the great circle through the 2 given points.

Parameters

<i>A</i>	The positive direction of the great circle.
<i>B</i>	The origin of the great circle.

2.59.3 Member Function Documentation

GetPointOnLine()

```
EquatorialPoint Umbrella2.WCS.EquatorialDistance.GreatLine.GetPointOnLine (
    double Distance)
```

Returns the point a given distance away (from B) on the great circle.

operator+()

```
static EquatorialPoint Umbrella2.WCS.EquatorialDistance.GreatLine.operator+ (
    GreatLine Vector,
    double Distance) [static]
```

Provides great circle navigation. Equivalent of GetPointOnLine.

operator~()

```
static double Umbrella2.WCS.EquatorialDistance.GreatLine.operator~ (
    GreatLine Vector) [static]
```

Returns the line length / spherical distance between the points on the sphere.

2.59.4 Member Data Documentation

A

```
Vector3D Umbrella2.WCS.EquatorialDistance.GreatLine.A [package]
```

AlphaAngle

`double Umbrella2.WCS.EquatorialDistance.GreatLine.AlphaAngle [package]`

B

`Vector3D Umbrella2.WCS.EquatorialDistance.GreatLine.B [package]`

2.60 Umbrella2.Pipeline.ExtraIO.Ades.GroupAttribute Class Reference

Represent an ADES group (of elements, see [ElementAttribute](#)).

Public Member Functions

- [GroupAttribute](#) (string groupName, bool nest)

Public Attributes

- string [GroupName](#)
Name of the group, as shown in ADES specification.
- bool [Nest](#)
If `true` nest, otherwise flatten the XML hierarchy.

2.60.1 Detailed Description

Represent an ADES group (of elements, see [ElementAttribute](#)).

2.60.2 Constructor & Destructor Documentation

GroupAttribute()

```
Umbrella2.Pipeline.ExtraIO.Ades.GroupAttribute.GroupAttribute (  
    string groupName,  
    bool nest)
```

2.60.3 Member Data Documentation

GroupName

```
string Umbrella2.Pipeline.ExtraIO.Ades.GroupAttribute.GroupName
```

Name of the group, as shown in ADES specification.

Nest

```
bool Umbrella2.Pipeline.ExtraIO.Ades.GroupAttribute.Nest
```

If `true` nest, otherwise flatten the XML hierarchy.

2.61 Umbrella2.Algorithms.Images.HardMedians Class Reference

Class of strict median filtering algorithms.

Static Public Member Functions

- static [SchedCore.AlgorithmRunParameters WeightedMedianParameters](#) (int PSFRadius)
Algorithm parameters for the weighted median filter.

Static Public Attributes

- static [SchedCore.SimpleMap< double\[\] > WeightedMedian](#) = [EstimatorFR.EstimatorFRMedian](#)
Filters the input using a weighted median filter. The argument is the PSF importance distribution (here it functions as the median weights).

Properties

- static [SchedCore.AlgorithmRunParameters MultiImageMedianParameters](#) [get]
Algorithm parameters for a multi-image median filter.
- static [SchedCore.Combiner< object > MultiImageMedian](#) [get]
Computes the median image of multiple input images. WCS information must be passed to the algorithm.

Static Private Member Functions

- static void [WeightedMedianAlgorithm](#) (double[,] Input, double[,] Output, double[] PSF)
Computes the weighted median of the input.
- static void [MultiImageMedianFilter](#) (double[,] Inputs, double[,] Output, [SchedCore.ImageSegmentPosition\[\]](#) InputPositions, [SchedCore.ImageSegmentPosition](#) OutputPosition, object empty)
Performs a median filter between multiple data sets.

2.61.1 Detailed Description

Class of strict median filtering algorithms.

2.61.2 Member Function Documentation**MultiImageMedianFilter()**

```
static void Umbrella2.Algorithms.Images.HardMedians.MultiImageMedianFilter (
    double Inputs[,] ,
    double Output[,] ,
    SchedCore.ImageSegmentPosition[] InputPositions,
    SchedCore.ImageSegmentPosition OutputPosition,
    object empty) [static], [private]
```

Performs a median filter between multiple data sets.

Parameters

<i>Inputs</i>	Input data.
<i>Output</i>	Output data.
<i>InputPositions</i>	Input alignments.
<i>OutputPosition</i>	Output alignment.
<i>empty</i>	Dummy argument.

WeightedMedianAlgorithm()

```
static void Umbrella2.Algorithms.Images.HardMedians.WeightedMedianAlgorithm (
    double Input[,],
    double Output[,],
    double[] PSF) [static], [private]
```

Computes the weighted median of the input.

Parameters

<i>Input</i>	Input data.
<i>Output</i>	Output data.
<i>PSF</i>	PSF importance distribution / median weights.

WeightedMedianParameters()

```
static SchedCore.AlgorithmRunParameters Umbrella2.Algorithms.Images.HardMedians.Weighted↔
MedianParameters (
    int PSFRadius) [static]
```

Algorithm parameters for the weighted median filter.

Parameters

<i>PSFRadius</i>	Radius of the PSF importance distribution.
------------------	--

2.61.3 Member Data Documentation**WeightedMedian**

```
SchedCore.SimpleMap<double[]> Umbrella2.Algorithms.Images.HardMedians.WeightedMedian = Estimator↔
FR.EstimatorFRMedian [static]
```

Filters the input using a weighted median filter. The argument is the PSF importance distribution (here it functions as the median weights).

2.61.4 Property Documentation

MultimageMedian

`SchedCore.Combiner`<object> Umbrella2.Algorithms.Images.HardMedians.MultiImageMedian [static], [get]

Computes the median image of multiple input images. [WCS](#) information must be passed to the algorithm.

MultimageMedianParameters

`SchedCore.AlgorithmRunParameters` Umbrella2.Algorithms.Images.HardMedians.MultiImageMedian↔Parameters [static], [get]

Algorithm parameters for a multi-image median filter.

The algorithm used does not match [WCS](#) at file reading, hence it must overscan (`InputMargins > 0`). The implicit `InputMargins` is 50, corresponding to a maximum displacement of 50px between the same [WCS](#) point on 2 different images.

2.62 Umbrella2.IO.FITS.HeaderExtensions Class Reference

Extension methods for working with [FITS](#) headers.

Static Public Member Functions

- static [MetadataRecord ThrowingGet](#) (this `HeaderTable` header, string name, string reason)
Dictionary access for header keywords which throws a [MissingKeywordException](#) if the keyword is not found.

2.62.1 Detailed Description

Extension methods for working with [FITS](#) headers.

2.62.2 Member Function Documentation

ThrowingGet()

```
static MetadataRecord Umbrella2.IO.FITS.HeaderExtensions.ThrowingGet (
    this HeaderTable header,
    string name,
    string reason) [static]
```

Dictionary access for header keywords which throws a [MissingKeywordException](#) if the keyword is not found.

Returns

The [MetadataRecord](#) associated with the given keyword.

Parameters

<i>header</i>	Header.
<i>name</i>	Keyword to retrieve.
<i>reason</i>	Reason why the requested keyword is required..

2.63 Umbrella2.IO.FITS.HeaderIO Class Reference

Contains functions for reading [FITS](#) headers.

Static Public Member Functions

- static long [ComputeDataArrayLength](#) (Dictionary< string, [MetadataRecord](#) > Header)
Computes the length of a data array in a HDU.

Static Package Functions

- static Tuple< List< [MetadataRecord](#) >, HeaderTable > [ReadHeaderFromStream](#) (Stream stream, long Length)
Reads a [FITS](#) header from a stream.
- static [FitsFileBuilder](#) [ReadFileHeaders](#) (Stream stream, long Length, MEFImageNumberGetter number← Getter)
Reads the [FITS](#) headers from a stream.

Static Private Member Functions

- static List< [KeywordRecord](#) > [ReadHeader](#) (Stream s, long Length)
Reads a [FITS](#) header from a stream.

Static Private Attributes

- static bool [IgnoreBadRecords](#) = false
if set to `true`, records with broken text may be ignored.
- static int [MaxBadRecords](#) = 1000
Maximum number of broken records before giving up on a file.

2.63.1 Detailed Description

Contains functions for reading [FITS](#) headers.

2.63.2 Member Function Documentation

ComputeDataArrayLength()

```
static long Umbrella2.IO.FITS.HeaderIO.ComputeDataArrayLength (
    Dictionary< string, MetadataRecord > Header) [static]
```

Computes the length of a data array in a HDU.

Parameters

<i>Header</i>	The header for which to compute the array length.
---------------	---

Returns

Array length in bytes.

ReadFileHeaders()

```
static FitsFileBuilder Umbrella2.IO.FITS.HeaderIO.ReadFileHeaders (
    Stream stream,
    long Length,
    MEImageNumberGetter numberGetter) [static], [package]
```

Reads the [FITS](#) headers from a stream.

Parameters

<i>stream</i>	Input stream.
<i>Length</i>	Expected stream length.
<i>numberGetter</i>	The function which assigns image numbers to FITS images in file.

Returns

A [FitsFileBuilder](#) containing the information from the headers.

ReadHeader()

```
static List< KeywordRecord > Umbrella2.IO.FITS.HeaderIO.ReadHeader (
    Stream s,
    long Length) [static], [private]
```

Reads a [FITS](#) header from a stream.

Parameters

<i>s</i>	Input stream.
<i>Length</i>	Expected length of input stream.

Returns

A list with all raw keyword records in the header.

ReadHeaderFromStream()

```
static Tuple< List< MetadataRecord >, HeaderTable > Umbrella2.IO.FITS.HeaderIO.ReadHeader↔
FromStream (
    Stream stream,
    long Length) [static], [package]
```

Reads a [FITS](#) header from a stream.

Parameters

<i>stream</i>	Input stream.
<i>Length</i>	Expected length of the input stream.

Returns

A tuple containing a list and a dictionary of the header records.

2.63.3 Member Data Documentation**IgnoreBadRecords**

```
bool Umbrella2.IO.FITS.HeaderIO.IgnoreBadRecords = false [static], [private]
```

if set to `true`, records with broken text may be ignored.

MaxBadRecords

```
int Umbrella2.IO.FITS.HeaderIO.MaxBadRecords = 1000 [static], [private]
```

Maximum number of broken records before giving up on a file.

2.64 Umbrella2.IO.FITS.HeaderTableUtil Class Reference**Static Public Member Functions**

- static void [CheckThrowRecord](#) (this Dictionary< string, [MetadataRecord](#) > Table, [Image Image](#), string Key)

2.64.1 Member Function Documentation**CheckThrowRecord()**

```
static void Umbrella2.IO.FITS.HeaderTableUtil.CheckThrowRecord (  
    this Dictionary< string, MetadataRecord > Table,  
    Image Image,  
    string Key) [static]
```

2.65 Umbrella2.Algorithms.Filtering.Helper Class Reference**Static Public Member Functions**

- static [BadzoneFilter.Vector Sub](#) ([PixelPoint a](#), [PixelPoint b](#))
Creates a vector from a 2 points.

2.65.1 Member Function Documentation

Sub()

```
static BadzoneFilter.Vector Umbrella2.Algorithms.Filtering.Helper.Sub (  
    PixelPoint a,  
    PixelPoint b) [static]
```

Creates a vector from a 2 points.

2.66 Umbrella2.Algorithms.Images.RLHT.HTResult Struct Reference

Result of running a Hough Transform.

Package Attributes

- [double\[,\] HTMatrix](#)
- [List< Vector > StrongPoints](#)

2.66.1 Detailed Description

Result of running a Hough Transform.

2.66.2 Member Data Documentation

HTMatrix

```
double [,] Umbrella2.Algorithms.Images.RLHT.HTResult.HTMatrix [package]
```

StrongPoints

```
List<Vector> Umbrella2.Algorithms.Images.RLHT.HTResult.StrongPoints [package]
```

2.67 Umbrella2.IO.IBackingFile Interface Reference

Represent a file backing an [Image](#).

Public Member Functions

- [void ReleaseResources \(\)](#)
Release the resources used by the file, but keep the file available for transparent re-opening.

Properties

- string [PathString](#) [get]
Path to the file. Note this may not always be a path in the filesystem.

2.67.1 Detailed Description

Represent a file backing an [Image](#).

2.67.2 Member Function Documentation

ReleaseResources()

```
void Umbrella2.IO.IBackingFile.ReleaseResources ()
```

Release the resources used by the file, but keep the file available for transparent re-opening.

This drops buffers (if any), memory maps and other similar OS resources, keeping only the headers in-memory. This ensures that the programs written using [Umbrella2](#) can keep a low footprint even when working with many large files.

Implemented in [Umbrella2.IO.FITS.FitsFile](#).

2.67.3 Property Documentation

PathString

```
string Umbrella2.IO.IBackingFile.PathString [get]
```

Path to the file. Note this may not always be a path in the filesystem.

The backing file may be on a network, so the path may be an URL, or the file may be inside an archive, so parsing this path may not be possible all the time. Nonetheless, it is expected that in most cases, this path will be a filesystem path.

Implemented in [Umbrella2.IO.FITS.FitsFile](#).

2.68 Umbrella2.IO.ICHV Class Reference

[Image](#) Core Header Values. A wrapper for the core data in Images' header data.

Public Attributes

- uint [Width](#)
Image width.
- uint [Height](#)
Image height.
- [IWCSProjection WCS](#)
Image WCS.
- HeaderTable [Header](#)
Header table.
- int [ImageNumber](#)
The number of the image in a multi-image file.

2.68.1 Detailed Description

[Image](#) Core Header Values. A wrapper for the core data in Images' header data.

2.68.2 Member Data Documentation

Header

```
HeaderTable Umbrella2.IO.ICHV.Header
```

Header table.

Height

```
uint Umbrella2.IO.ICHV.Height
```

[Image](#) height.

ImageNumber

```
int Umbrella2.IO.ICHV.ImageNumber
```

The number of the image in a multi-image file.

WCS

```
IWCSProjection Umbrella2.IO.ICHV.WCS
```

[Image](#) WCS.

Width

```
uint Umbrella2.IO.ICHV.Width
```

[Image](#) width.

2.69 Umbrella2.Pipeline.ExtraIO.Ades.IdentificationGroup Class Reference

The Identification Group includes four elements that are used to identify the object associated with the observation.

Public Attributes

- string [PermanentId](#)
IAU permanent designation, e.g., the IAU number for a numbered minor planet.
- string [MpcProvisionalId](#)
MPC provisional designation (in unpacked form) for unnumbered objects.
- string [ArtificialSattelitelId](#)
Artificial satellite identifier.
- string [TrackletIdentifier](#)
Observer-assigned tracklet identifier, unique within a submission batch.
- string [UniqueObservationID](#)
Globally unique observation identifier assigned by the MPC. For observers, this field can be used to communicate a correction to a previously published observation.
- string [ObservationLocalID](#)
Observation identifier, optionally included with the submission, that is unique to a given observing program. This element is intended to support extended analyses associated with major observing programs.
- string [UniqueTrackledID](#)
Globally Unique alphanumeric tracklet ID assigned by MPC.
- string [MpcTrackletID2](#)
MPC-internal tracklet identifier, used in cases where the value of the `trkSub` element should be considered deprecated.
- string [InstrumentType](#)
Mode of optical and offset observations.
- string [ObsCode](#)
Observatory code from MPC list. The old three-character codes will be preserved where practical, or a fourth character will be added, e.g., 568a, 568b, etc. The list of `stn` codes and associated locations to be provided and maintained by the MPC.

2.69.1 Detailed Description

The Identification Group includes four elements that are used to identify the object associated with the observation.

There are four alternate presentations for these elements. At least one of the elements is always required to be present, and, unless it is the only element present, `trkSub` is always optional.

2.69.2 Member Data Documentation

ArtificialSattelitelId

```
string Umbrella2.Pipeline.ExtraIO.Ades.IdentificationGroup.ArtificialSattelitelId
```

Artificial satellite identifier.

InstrumentType

```
string Umbrella2.Pipeline.ExtraIO.Ades.IdentificationGroup.InstrumentType
```

Mode of optical and offset observations.

PHO – Photographic ENC – Encoder CCD – CCD MER – Meridian or transit circle MIC – Micrometer NOR – Normal place VID – Mini-normal place from video frames PMT – Photo-multiplier tube

MpcProvisionalId

```
string Umbrella2.Pipeline.ExtraIO.Ades.IdentificationGroup.MpcProvisionalId
```

MPC provisional designation (in unpacked form) for unnumbered objects.

MpcTrackletID2

```
string Umbrella2.Pipeline.ExtraIO.Ades.IdentificationGroup.MpcTrackletID2
```

MPC-internal tracklet identifier, used in cases where the value of the `trkSub` element should be considered deprecated.

ObsCode

```
string Umbrella2.Pipeline.ExtraIO.Ades.IdentificationGroup.ObsCode
```

Observatory code from MPC list. The old three-character codes will be preserved where practical, or a fourth character will be added, e.g., 568a, 568b, etc. The list of stn codes and associated locations to be provided and maintained by the MPC.

ObservationLocalID

```
string Umbrella2.Pipeline.ExtraIO.Ades.IdentificationGroup.ObservationLocalID
```

Observation identifier, optionally included with the submission, that is unique to a given observing program. This element is intended to support extended analyses associated with major observing programs.

PermanentId

```
string Umbrella2.Pipeline.ExtraIO.Ades.IdentificationGroup.PermanentId
```

IAU permanent designation, e.g., the IAU number for a numbered minor planet.

TrackletIdentifier

```
string Umbrella2.Pipeline.ExtraIO.Ades.IdentificationGroup.TrackletIdentifier
```

Observer-assigned tracklet identifier, unique within a submission batch.

Not altered by the MPC. This will typically be the same as the observer-assigned temporary designation previously employed for the MPC1992 format. This element can be used to distinguish individual tracklets among observations of the same object within a submission. This element can also be used by an observatory to facilitate tracebacks from MPC distributions to observer submissions.

UniqueObservationID

```
string Umbrella2.Pipeline.ExtraIO.Ades.IdentificationGroup.UniqueObservationID
```

Globally unique observation identifier assigned by the MPC. For observers, this field can be used to communicate a correction to a previously published observation.

UniqueTrackledID

```
string Umbrella2.Pipeline.ExtraIO.Ades.IdentificationGroup.UniqueTrackledID
```

Globally Unique alphanumeric tracklet ID assigned by MPC.

2.70 Umbrella2.PropertyModel.IExtendable Interface Reference

Public Member Functions

- T [FetchProperty](#)< T > ()
Fetches a property of the [ImageDetection](#). Not thread-safe when also appending properties concurrently.
- bool [TryFetchProperty](#)< T > (out T Property)
Tries fetching a property of the [ImageDetection](#).
- T [FetchOrCreate](#)< T > ()
Tries fetching a property of the [ImageDetection](#) or creates a new one.
- void [AppendProperty](#)< T > (T Property)
Appends a property to the object.
- void [SetResetProperty](#)< T > (T Property)
Appends or overwrites a property.

Properties

- Dictionary< Type, [IExtensionProperty](#) > [ExtendedProperties](#) [get]
List of supplementary properties.

2.70.1 Member Function Documentation

[AppendProperty](#)< T >()

```
void Umbrella2.PropertyModel.IExtendable.AppendProperty< T > (
    T Property)
```

Appends a property to the object.

Note that this function sets the property type according to the generic type parameter.

Template Parameters

<i>T</i>	Property type.
----------	----------------

Parameters

<i>Property</i>	Property instance.
-----------------	--------------------

Implemented in [Umbrella2.ImageDetection](#), and [Umbrella2.Tracklet](#).

Type Constraints

T : IExtensionProperty

FetchOrCreate< T >()

`T Umbrella2.PropertyModel.IExtendable.FetchOrCreate< T > ()`

Tries fetching a property of the [ImageDetection](#) or creates a new one.

Template Parameters

<i>T</i>	Property type.
----------	----------------

Returns

Property instance on the object or the default value of the type.

Implemented in [Umbrella2.ImageDetection](#), and [Umbrella2.Tracklet](#).

Type Constraints

T : IExtensionProperty

T : new()

FetchProperty< T >()

`T Umbrella2.PropertyModel.IExtendable.FetchProperty< T > ()`

Fetches a property of the [ImageDetection](#). Not thread-safe when also appending properties concurrently.

Template Parameters

<i>T</i>	Property type.
----------	----------------

Returns

The property, casted to the appropriate type.

Implemented in [Umbrella2.ImageDetection](#), and [Umbrella2.Tracklet](#).

Type Constraints

T : IExtensionProperty

SetResetProperty< T >()

`void Umbrella2.PropertyModel.IExtendable.SetResetProperty< T > (
T Property)`

Appends or overwrites a property.

Template Parameters

<i>T</i>	Property type.
----------	----------------

Parameters

<i>Property</i>	Property instance.
-----------------	--------------------

Implemented in [Umbrella2.ImageDetection](#), and [Umbrella2.Tracklet](#).

Type Constraints

T : IExtensionProperty

TryFetchProperty< T >()

```
bool Umbrella2.PropertyModel.IExtendable.TryFetchProperty< T > (
    out T Property)
```

Tries fetching a property of the [ImageDetection](#).

Template Parameters

<i>T</i>	Property type.
----------	----------------

Parameters

<i>Property</i>	Property instance on the object.
-----------------	----------------------------------

Returns

True if property exists.

Implemented in [Umbrella2.ImageDetection](#), and [Umbrella2.Tracklet](#).

Type Constraints

T : IExtensionProperty

T : new()

2.70.2 Property Documentation**ExtendedProperties**

```
Dictionary<Type, IExtensionProperty> Umbrella2.PropertyModel.IExtendable.ExtendedProperties
[get]
```

List of supplementary properties.

The held values should be reference types; otherwise boxing will make them read-only.

Implemented in [Umbrella2.ImageDetection](#), and [Umbrella2.Tracklet](#).

2.71 Umbrella2.PropertyModel.IExtensionProperty Interface Reference

Used to denote a property that can be attached to an object.

2.71.1 Detailed Description

Used to denote a property that can be attached to an object.

2.72 Umbrella2.IO.FITS.IFitsParsingError Interface Reference

Catch-all for known parsing errors in handling [FITS](#) files and images.

Properties

- string [ProblemKeyword](#) [get]

Keyword which triggered this issue. May be null. Note this may not always point to the problem record, as previous records may have put the parsing code in a state where this specific keyword is not valid, although normally it would be fine.

2.72.1 Detailed Description

Catch-all for known parsing errors in handling [FITS](#) files and images.

2.72.2 Property Documentation

ProblemKeyword

```
string Umbrella2.IO.FITS.IFitsParsingError.ProblemKeyword [get]
```

Keyword which triggered this issue. May be null. Note this may not always point to the problem record, as previous records may have put the parsing code in a state where this specific keyword is not valid, although normally it would be fine.

Implemented in [Umbrella2.IO.FITS.FitsArgumentOutOfRangeException](#), [Umbrella2.IO.FITS.FitsDriverException](#), [Umbrella2.IO.FITS.FitsNotStandardException](#), [Umbrella2.IO.FITS.FitsRecordException](#), [Umbrella2.IO.FITS.MissingKeywordException](#) and [Umbrella2.IO.FITS.UnsupportedFitsValueException](#).

2.73 Umbrella2.Visualizer.WinForms.IFitsViewScaler Interface Reference

Represents an image scaling algorithm, for compressing the double precision floating point input to an 8-bit pixel value.

Public Member Functions

- byte [GetValue](#) (double Input)

Scales the input data to an appropriate image value.

2.73.1 Detailed Description

Represents an image scaling algorithm, for compressing the double precision floating point input to an 8-bit pixel value.

2.73.2 Member Function Documentation

GetValue()

```
byte Umbrella2.Visualizer.WinForms.IFitsViewScaler.GetValue (  
    double Input)
```

Scales the input data to an appropriate image value.

Parameters

<i>Input</i>	Input value.
--------------	--------------

Returns

An 8-bit pixel intensity.

Implemented in [Umbrella2.Visualizer.WinForms.LinearScaler](#).

2.74 Umbrella2.Algorithms.Filtering.ImageDetectionFilter Interface Reference

Public Member Functions

- bool [Filter](#) ([ImageDetection](#) Input)

2.74.1 Member Function Documentation

Filter()

```
bool Umbrella2.Algorithms.Filtering.IImageDetectionFilter.Filter (  
    ImageDetection Input)
```

Implemented in [Umbrella2.Algorithms.Filtering.BadzoneFilter](#), [Umbrella2.Algorithms.Filtering.BrightnessThicknessFilter](#), and [Umbrella2.Algorithms.Filtering.LinearityThresholdFilter](#).

2.75 Umbrella2.IO.Image Class Reference

Public Member Functions

- Dictionary< Type, [ImageProperties](#) > [GetAllProperties](#) ()
Returns all associated image properties.
- [ICHV GetICHV](#) ()
*Gets the *Image*'s headers.*
- T [GetProperty](#)< T > ()
Fetches the image properties of given type for the image. Caches the instance.
- bool [TryFetchProperty](#)< T > (out T Value)
Tries to fetch the image properties of the given type from the cache. Does not attempt to create a new instance if the properties are not found.
- void [CheckMarginsAndThrow](#) (Rectangle Area)
Checks whether the area of interest is within the boundaries of the image (see [IsInBounds\(Rectangle\)](#)) and throws if not.
- bool [IsInBounds](#) (Rectangle Area)
Checks whether the area of interest is within the boundaries.
- [ImageData LockData](#) (Rectangle Area, bool FillZero, bool RO=true)
Locks and returns the data of an image. Can be used for reading and writing.
- [ImageData SwitchLockData](#) ([ImageData](#) Data, int NewX, int NewY, bool FillZero, bool RO=true)
Replaces the data view with another at different coordinates, flushing any writable data. Same as [ExitLock](#) followed by [LockData](#), however does not require a new data buffer allocation.
- void [ExitLock](#) ([ImageData](#) Data)
Exits the lock on a region of image, flushing any writable data.
- Guid [RawLockImage](#) (bool RO, out IntPtr Pointer, out bool LittleEndian, out int BitsPerPixel)
Locks and returns the data of an image in raw format.
- void [ExitRawLock](#) (Guid Token, IntPtr Pointer)
Exits a raw lock on the image.

Public Attributes

- readonly uint [Width](#)
- readonly uint [Height](#)
- readonly int [ImageNumber](#)
The number of the image in a multi-image file. Is 0 for the primary image; begins at 1 for extensions and sub-frames.
- readonly [IWCSProjection Transform](#)
World Coordinate System Transformation. Depending on the image opening policy and missing metadata, may be null.
- readonly [ImageTiming Time](#)
Timing information of the image. Depending on the image opening policy and missing metadata, may be null.
- readonly HeaderTable [Header](#)
FITS Image Headers.

Protected Member Functions

- [Image](#) (int [ImageNumber](#), [IWCSProjection Transform](#), HeaderTable [Header](#), uint [Width](#), uint [Height](#))
- [Image](#) ([ICHV](#) Headers)
Creates a new instance from a set of headers.
- [Image](#) ([ICHV](#) Headers, Dictionary< Type, [ImageProperties](#) > Properties)
Creates a new instance from a set of headers and properties.

Protected Attributes

- readonly Dictionary< Type, [ImageProperties](#) > [PropertiesDictionary](#)
Extra [Image Properties](#).

Properties

- [IBackingFile BackingFile](#) [get]
Gets the file backing the current image.

2.75.1 Constructor & Destructor Documentation

Image() [1/3]

```
Umbrella2.IO.Image.Image (
    int ImageNumber,
    IWCSProjection Transform,
    HeaderTable Header,
    uint Width,
    uint Height) [protected]
```

Image() [2/3]

```
Umbrella2.IO.Image.Image (
    ICHV Headers) [protected]
```

Creates a new instance from a set of headers.

Parameters

<i>Headers</i>	Image headers.
----------------	--------------------------------

Image() [3/3]

```
Umbrella2.IO.Image.Image (
    ICHV Headers,
    Dictionary< Type, ImageProperties > Properties) [protected]
```

Creates a new instance from a set of headers and properties.

Parameters

<i>Headers</i>	Image headers.
<i>Properties</i>	Image properties.

2.75.2 Member Function Documentation

CheckMarginsAndThrow()

```
void Umbrella2.IO.Image.CheckMarginsAndThrow (
    Rectangle Area) [abstract]
```

Checks whether the area of interest is within the boundaries of the image (see [IsInBounds\(Rectangle\)](#)) and throws if not.

Parameters

<i>Area</i>	Area of interest.
-------------	-------------------

ExitLock()

```
void Umbrella2.IO.Image.ExitLock (
    ImageData Data) [abstract]
```

Exits the lock on a region of image, flushing any writable data.

Parameters

<i>Data</i>	The data container.
-------------	---------------------

ExitRawLock()

```
void Umbrella2.IO.Image.ExitRawLock (
    Guid Token,
    IntPtr Pointer) [abstract]
```

Exits a raw lock on the image.

Parameters

<i>Token</i>	Lock token.
<i>Pointer</i>	Pointer to raw image data.

GetAllProperties()

```
Dictionary< Type, ImageProperties > Umbrella2.IO.Image.GetAllProperties ()
```

Returns all associated image properties.

Returns

All image properties.

GetICHV()

```
ICHV Umbrella2.IO.Image.GetICHV ()
```

Gets the [Image](#)'s headers.

GetProperty< T >()

```
T Umbrella2.IO.Image.GetProperty< T > ()
```

Fetches the image properties of given type for the image. Caches the instance.

Template Parameters

<i>T</i>	Type of the image properties.
----------	-------------------------------

Returns

The image properties instance associated with the image.

Type Constraints

T : ImageProperties

IsInBounds()

```
bool Umbrella2.IO.Image.IsInBounds (
    Rectangle Area) [abstract]
```

Checks whether the area of interest is within the boundaries.

Returns

`true`, if the *Area* is fully contained inside the image, `false` otherwise.

Parameters

<i>Area</i>	Area of interest.
-------------	-------------------

LockData()

```
ImageData Umbrella2.IO.Image.LockData (
    Rectangle Area,
    bool FillZero,
    bool RO = true) [abstract]
```

Locks and returns the data of an image. Can be used for reading and writing.

Parameters

<i>Area</i>	Area of interest in the image.
<i>FillZero</i>	True for padding out of image margins with zero. Must be false for write access.
<i>RO</i>	Whether the data is read-only.

Returns

An [ImageData](#) container.

RawLockImage()

```
Guid Umbrella2.IO.Image.RawLockImage (
    bool RO,
    out IntPtr Pointer,
    out bool LittleEndian,
    out int BitsPerPixel) [abstract]
```

Locks and returns the data of an image in raw format.

Returns

The lock token.

Parameters

<i>RO</i>	If set to <code>true</code> , the lock is acquired for reading.
<i>Pointer</i>	Pointer to raw image data.
<i>LittleEndian</i>	If set to <code>true</code> , the data is little-endian. The data is big-endian otherwise.
<i>BitsPerPixel</i>	The number of bits per pixel. Positive if integer valued, negative if IEEE 754.

SwitchLockData()

```
ImageData Umbrella2.IO.Image.SwitchLockData (
    ImageData Data,
    int NewX,
    int NewY,
    bool FillZero,
    bool RO = true) [abstract]
```

Replaces the data view with another at different coordinates, flushing any writable data. Same as `ExitLock` followed by `LockData`, however does not require a new data buffer allocation.

Parameters

<i>Data</i>	Previous data.
<i>NewX</i>	New X coordinate.
<i>NewY</i>	New Y coordinate.
<i>FillZero</i>	True for padding out of image margins with zero. Must be false for write access.
<i>RO</i>	Whether the data is read-only.

Returns

An [ImageData](#) container.

TryFetchProperty< T >()

```
bool Umbrella2.IO.Image.TryFetchProperty< T > (
    out T Value)
```

Tries to fetch the image properties of the given type from the cache. Does not attempt to create a new instance if the properties are not found.

Returns

`true`, if the fetch was successful, `false` otherwise.

Parameters

<i>Value</i>	The image properties instance associated with the image.
--------------	--

Template Parameters

<i>T</i>	Type of the image properties.
----------	-------------------------------

Type Constraints

T : ImageProperties

2.75.3 Member Data Documentation**Header**

```
readonly HeaderTable Umbrella2.IO.Image.Header
```

[FITS Image](#) Headers.

Height

```
readonly uint Umbrella2.IO.Image.Height
```

ImageNumber

```
readonly int Umbrella2.IO.Image.ImageNumber
```

The number of the image in a multi-image file. Is 0 for the primary image; begins at 1 for extensions and sub-frames.

PropertiesDictionary

```
readonly Dictionary<Type, ImageProperties> Umbrella2.IO.Image.PropertiesDictionary [protected]
```

Extra [Image](#) Properties.

Time

```
readonly ImageTiming Umbrella2.IO.Image.Time
```

Timing information of the image. Depending on the image opening policy and missing metadata, may be null.

Transform

readonly [IWCSProjection](#) Umbrella2.IO.Image.Transform

World Coordinate System Transformation. Depending on the image opening policy and missing metadata, may be null.

Width

readonly uint Umbrella2.IO.Image.Width

2.75.4 Property Documentation

BackingFile

[IBackingFile](#) Umbrella2.IO.Image.BackingFile [get], [abstract]

Gets the file backing the current image.

2.76 Umbrella2.IO.ImageData Struct Reference

[Image](#) data from a [FITS](#) File. The data is in the form [y, x].

Public Member Functions

- [ImageData](#) (Rectangle Location, double[,], [ImageData](#), [Image Image](#), bool Readonly, Guid UID)

Public Attributes

- readonly Rectangle [Position](#)
The position in the image of the current data.
- double[,], [Data](#)
The pixel values in the image. First index is the Y axis.
- readonly [Image Parent](#)
The image to which this data belongs.
- readonly bool [ReadOnly](#)
Whether the data is readonly or not.

Package Attributes

- readonly Guid [FDGuid](#)

2.76.1 Detailed Description

[Image](#) data from a [FITS](#) File. The data is in the form [y, x].

2.76.2 Constructor & Destructor Documentation

ImageData()

```
Umbrella2.IO.ImageData.ImageData (  
    Rectangle Location,  
    double ImageData[],  
    Image Image,  
    bool ReadOnly,  
    Guid UID)
```

2.76.3 Member Data Documentation

Data

```
double [,] Umbrella2.IO.ImageData.Data
```

The pixel values in the image. First index is the Y axis.

FDGuid

```
readonly Guid Umbrella2.IO.ImageData.FDGuid [package]
```

Parent

```
readonly Image Umbrella2.IO.ImageData.Parent
```

The image to which this data belongs.

Position

```
readonly Rectangle Umbrella2.IO.ImageData.Position
```

The position in the image of the current data.

ReadOnly

```
readonly bool Umbrella2.IO.ImageData.ReadOnly
```

Whether the data is readonly or not.

2.77 Umbrella2.ImageDetection Class Reference

The detection on an image of an object.

Public Member Functions

- [ImageDetection](#) ([Position Barycenter](#), [ObservationTime Time](#), [Image ParentImage](#))
Creates a [ImageDetection](#) from the given arguments. This constructor is internally called by the [ImageDetection](#) factories.
- [ImageDetection](#) ()
Empty constructor, for easier use with reflection.
- [T FetchProperty](#)< T > ()
Fetches a property of the [ImageDetection](#). Not thread-safe when also appending properties concurrently.
- [bool TryFetchProperty](#)< T > (out T Property)
Tries fetching a property of the [ImageDetection](#).
- [T FetchOrCreate](#)< T > ()
Tries fetching a property of the [ImageDetection](#) or creates a new one.
- [void AppendProperty](#)< T > (T Property)
Appends a property to the object.
- [void SetResetProperty](#)< T > (T Property)
Appends or overwrites a property.

Public Attributes

- readonly [Position Barycenter](#)
Position of the flux barycenter.
- readonly [ObservationTime Time](#)
Exposure information.
- readonly [Image ParentImage](#)
Image on which the detection was observed.

Properties

- [Dictionary](#)< Type, [IExtensionProperty](#) > [ExtendedProperties](#) [get]
List of supplementary properties.

Properties inherited from [Umbrella2.PropertyModel.IExtendable](#)

2.77.1 Detailed Description

The detection on an image of an object.

2.77.2 Constructor & Destructor Documentation

[ImageDetection](#)() [1/2]

```
Umbrella2.ImageDetection.ImageDetection (
    Position Barycenter,
    ObservationTime Time,
    Image ParentImage)
```

Creates a [ImageDetection](#) from the given arguments. This constructor is internally called by the [ImageDetection](#) factories.

ImageDetection() [2/2]

```
Umbrella2.ImageDetection.ImageDetection ()
```

Empty constructor, for easier use with reflection.

2.77.3 Member Function Documentation**AppendProperty< T >()**

```
void Umbrella2.ImageDetection.AppendProperty< T > (  
    T Property)
```

Appends a property to the object.

Note that this function sets the property type according to the generic type parameter.

Template Parameters

<i>T</i>	Property type.
----------	----------------

Parameters

<i>Property</i>	Property instance.
-----------------	--------------------

Implements [Umbrella2.PropertyModel.IExtendable](#).

Type Constraints

T* : *IExtensionProperty

FetchOrCreate< T >()

```
T Umbrella2.ImageDetection.FetchOrCreate< T > ()
```

Tries fetching a property of the [ImageDetection](#) or creates a new one.

Template Parameters

<i>T</i>	Property type.
----------	----------------

Returns

Property instance on the object or the default value of the type.

Implements [Umbrella2.PropertyModel.IExtendable](#).

Type Constraints

T* : *IExtensionProperty

T* : *new()

FetchProperty< T >()

```
T Umbrella2.ImageDetection.FetchProperty< T > ()
```

Fetches a property of the [ImageDetection](#). Not thread-safe when also appending properties concurrently.

Template Parameters

<i>T</i>	Property type.
----------	----------------

Returns

The property, casted to the appropriate type.

Implements [Umbrella2.PropertyModel.IExtendable](#).

Type Constraints

T : IExtensionProperty

SetResetProperty< T >()

```
void Umbrella2.ImageDetection.SetResetProperty< T > (  
    T Property)
```

Appends or overwrites a property.

Template Parameters

<i>T</i>	Property type.
----------	----------------

Parameters

<i>Property</i>	Property instance.
-----------------	--------------------

Implements [Umbrella2.PropertyModel.IExtendable](#).

Type Constraints

T : IExtensionProperty

TryFetchProperty< T >()

```
bool Umbrella2.ImageDetection.TryFetchProperty< T > (  
    out T Property)
```

Tries fetching a property of the [ImageDetection](#).

Template Parameters

<i>T</i>	Property type.
----------	----------------

Parameters

<i>Property</i>	Property instance on the object.
-----------------	----------------------------------

Returns

True if property exists.

Implements [Umbrella2.PropertyModel.IExtendable](#).

Type Constraints

T : *IExtensionProperty*

T : *new()*

2.77.4 Member Data Documentation

Barycenter

readonly [Position](#) Umbrella2.ImageDetection.Barycenter

[Position](#) of the flux barycenter.

ParentImage

readonly [Image](#) Umbrella2.ImageDetection.ParentImage

Image on which the detection was observed.

Time

readonly [ObservationTime](#) Umbrella2.ImageDetection.Time

Exposure information.

2.77.5 Property Documentation

ExtendedProperties

Dictionary<Type, [IExtensionProperty](#)> Umbrella2.ImageDetection.ExtendedProperties [get]

List of supplementary properties.

The held values should be reference types; otherwise boxing will make them read-only.

Implements [Umbrella2.PropertyModel.IExtendable](#).

2.78 Umbrella2.Algorithms.Filtering.ImageDetectionFilterTools Class Reference

Provides filtering for sources.

Static Public Member Functions

- static List< [ImageDetection](#) > [Filter](#) (List< [ImageDetection](#) > Input, params Predicate< [ImageDetection](#) >[] Filters)
Runs the given filters in parallel over the input.

2.78.1 Detailed Description

Provides filtering for sources.

2.78.2 Member Function Documentation

Filter()

```
static List< ImageDetection > Umbrella2.Algorithms.Filtering.ImageDetectionFilterTools.Filter
(
    List< ImageDetection > Input,
    params Predicate< ImageDetection >[] Filters) [static]
```

Runs the given filters in parallel over the input.

Parameters

<i>Input</i>	Input sources.
<i>Filters</i>	Filters to be run. Each filter should return true for the source to pass.

Returns

Filtered input sources.

2.79 Umbrella2.Algorithms.Images.RLHT.ImageParameters Struct Reference

Bag of data containing thresholds and detection algorithm image-specific parameters.

Package Attributes

- double [ZeroLevel](#)
- double [IncreasingThreshold](#)
- double [MaxMultiplier](#)
- double [MaxRatio](#)
- double [DefaultRatio](#)
- int [ShortAvgLength](#)
- int [LongAvgLength](#)

2.79.1 Detailed Description

Bag of data containing thresholds and detection algorithm image-specific parameters.

2.79.2 Member Data Documentation

DefaultRatio

double Umbrella2.Algorithms.Images.RLHT.ImageParameters.DefaultRatio [package]

IncreasingThreshold

double Umbrella2.Algorithms.Images.RLHT.ImageParameters.IncreasingThreshold [package]

LongAvgLength

int Umbrella2.Algorithms.Images.RLHT.ImageParameters.LongAvgLength [package]

MaxMultiplier

double Umbrella2.Algorithms.Images.RLHT.ImageParameters.MaxMultiplier [package]

MaxRatio

double Umbrella2.Algorithms.Images.RLHT.ImageParameters.MaxRatio [package]

ShortAvgLength

int Umbrella2.Algorithms.Images.RLHT.ImageParameters.ShortAvgLength [package]

ZeroLevel

double Umbrella2.Algorithms.Images.RLHT.ImageParameters.ZeroLevel [package]

2.80 Umbrella2.IO.ImageProperties Class Reference

Represents a set of image properties that can be parsed from image metadata.

Public Member Functions

- [ImageProperties](#) ([Image](#) [Image](#))
Creates a new instance of the image properties for the given image.
- [List](#)< [MetadataRecord](#) > [GetRecords](#) ()
Gets the list of metadata records associated with the property.

2.80.1 Detailed Description

Represents a set of image properties that can be parsed from image metadata.

2.80.2 Constructor & Destructor Documentation

[ImageProperties](#)()

```
Umbrella2.IO.ImageProperties.ImageProperties (  
    Image Image)
```

Creates a new instance of the image properties for the given image.

Parameters

Image	The image for which the properties are extracted.
-----------------------	---

2.80.3 Member Function Documentation

[GetRecords](#)()

```
List< MetadataRecord > Umbrella2.IO.ImageProperties.GetRecords () [abstract]
```

Gets the list of metadata records associated with the property.

Returns

A list of metadata records.

2.81 Umbrella2.Algorithms.Images.SchedCore.ImageSegmentPosition Struct Reference

Represents the position of a block of data w.r.t. the image.

Public Attributes

- [PixelPoint Alignment](#)
Position of the data block in the image.
- [WCS.IWCSProjection](#) [WCS](#)
WCS coordinates of the image.

2.81.1 Detailed Description

Represents the position of a block of data w.r.t. the image.

2.81.2 Member Data Documentation

Alignment

`PixelPoint` `Umbrella2.Algorithms.Images.SchedCore.ImageSegmentPosition.Alignment`

`Position` of the data block in the image.

WCS

`WCS.IWCSProjection` `Umbrella2.Algorithms.Images.SchedCore.ImageSegmentPosition.WCS`

`WCS` coordinates of the image.

2.82 Umbrella2.Algorithms.Schedulers.ImageSegmentPosition Struct Reference

Represents the position of a block of data w.r.t. the image.

Public Attributes

- `PixelPoint Alignment`
Position of the data block in the image.
- `WCS.IWCSProjection WCS`
WCS coordinates of the image.

2.82.1 Detailed Description

Represents the position of a block of data w.r.t. the image.

2.82.2 Member Data Documentation

Alignment

`PixelPoint` `Umbrella2.Algorithms.Schedulers.ImageSegmentPosition.Alignment`

`Position` of the data block in the image.

WCS

`WCS.IWCSProjection` `Umbrella2.Algorithms.Schedulers.ImageSegmentPosition.WCS`

`WCS` coordinates of the image.

2.83 Umbrella2.PropertyModel.CommonProperties.ImageSet Class Reference

Represents a set of images of the same sky surface, each processed differently.

Public Member Functions

- [ImageSet \(Image Original\)](#)
Creates an [ImageSet](#) from a source image.
- void [AppendImage \(Image Image, string Name\)](#)
Appends an image to the set of derived images (variants).
- Dictionary< string, [Image](#) > [FetchVariants \(\)](#)
Fetches the set of derived images (variants) of the original image.

Public Attributes

- readonly [Image Original](#)
Source image of the sky surface.

Private Attributes

- readonly Dictionary< string, [Image](#) > [Variants](#)
The differently processed images available.

2.83.1 Detailed Description

Represents a set of images of the same sky surface, each processed differently.

2.83.2 Constructor & Destructor Documentation

ImageSet()

```
Umbrella2.PropertyModel.CommonProperties.ImageSet.ImageSet (  
    Image Original)
```

Creates an [ImageSet](#) from a source image.

2.83.3 Member Function Documentation

AppendImage()

```
void Umbrella2.PropertyModel.CommonProperties.ImageSet.AppendImage (  
    Image Image,  
    string Name)
```

Appends an image to the set of derived images (variants).

Parameters

<i>Image</i>	Derived image (variant).
<i>Name</i>	Name of the variant.

FetchVariants()

```
Dictionary< string, Image > Umbrella2.PropertyModel.CommonProperties.ImageSet.FetchVariants ()
```

Fetches the set of derived images (variants) of the original image.

Returns

A name-indexed dictionary containing the variants.

2.83.4 Member Data Documentation**Original**

```
readonly Image Umbrella2.PropertyModel.CommonProperties.ImageSet.Original
```

Source image of the sky surface.

Variants

```
readonly Dictionary<string, Image> Umbrella2.PropertyModel.CommonProperties.ImageSet.Variants  
[private]
```

The differently processed images available.

2.84 Umbrella2.PropertyModel.CommonProperties.ImageSource Class Reference

Represents the [ImageSet](#) an image belongs to.

Public Member Functions

- [ImageSource](#) ([Image Image](#))
Automatic constructor; may be used to bound to an [ImageSet](#).
- void [AddToSet](#) ([Image Element](#), string Name)
Adds an image to the set of another (original) image.
- override List< [MetadataRecord](#) > [GetRecords](#) ()

Public Member Functions inherited from [Umbrella2.IO.ImageProperties](#)

- [ImageProperties](#) ([Image Image](#))
Creates a new instance of the image properties for the given image.
- List< [MetadataRecord](#) > [GetRecords](#) ()
Gets the list of metadata records associated with the property.

Static Public Member Functions

- static [operator ImageSet \(ImageSource Source\)](#)
Retrieves the image's [ImageSet](#).

Private Attributes

- [ImageSet Set](#)
- [Image CurrentImage](#)

2.84.1 Detailed Description

Represents the [ImageSet](#) an image belongs to.

2.84.2 Constructor & Destructor Documentation

ImageSource()

```
Umbrella2.PropertyModel.CommonProperties.ImageSource.ImageSource (  
    Image Image)
```

Automatic constructor; may be used to bound to an [ImageSet](#).

2.84.3 Member Function Documentation

AddToSet()

```
void Umbrella2.PropertyModel.CommonProperties.ImageSource.AddToSet (  
    Image Element,  
    string Name)
```

Adds an image to the set of another (original) image.

Parameters

<i>Element</i>	Image from which the current one is derived.
<i>Name</i>	Name of the current image in the set.

GetRecords()

```
override List< MetadataRecord > Umbrella2.PropertyModel.CommonProperties.ImageSource.Get↔  
Records ()
```

operator ImageSet()

```
static Umbrella2.PropertyModel.CommonProperties.ImageSource.operator ImageSet (
    ImageSource Source) [explicit], [static]
```

Retrieves the image's [ImageSet](#).

2.84.4 Member Data Documentation**CurrentImage**

```
Image Umbrella2.PropertyModel.CommonProperties.ImageSource.CurrentImage [private]
```

Set

```
ImageSet Umbrella2.PropertyModel.CommonProperties.ImageSource.Set [private]
```

2.85 Umbrella2.Algorithms.Images.ImageStatistics Class Reference

Contains a set of information about the image.

Public Member Functions

- delegate void [StatisticsSolver](#) ([Image Image](#), out double [ZeroLevel](#), out double [StDev](#))
Signature of the solver algorithm used by [ImageStatistics](#) to obtain the background and noise levels.
- [ImageStatistics](#) ([Image Image](#))
Computes the [ImageStatistics](#) for a given image.
- [ImageStatistics](#) ([Image Image](#), double [ZeroLevel](#), double [StDev](#))
Creates an artificial set of statistics for an image.
- override List< [MetadataRecord](#) > [GetRecords](#) ()

Public Member Functions inherited from [Umbrella2.IO.ImageProperties](#)

- [ImageProperties](#) ([Image Image](#))
Creates a new instance of the image properties for the given image.
- List< [MetadataRecord](#) > [GetRecords](#) ()
Gets the list of metadata records associated with the property.

Public Attributes

- readonly double [ZeroLevel](#)
Background level.
- readonly double [StDev](#)
Noise standard deviations.

Static Private Attributes

- static [StatisticsSolver Solver](#) = [BasicImstatSolver.BasicSolver](#)

The computation function for solving image statistics.

2.85.1 Detailed Description

Contains a set of information about the image.

2.85.2 Constructor & Destructor Documentation

ImageStatistics() [1/2]

```
Umbrella2.Algorithms.Images.ImageStatistics.ImageStatistics (
    Image Image)
```

Computes the [ImageStatistics](#) for a given image.

Parameters

<i>Image</i>	Input image.
--------------	--------------

ImageStatistics() [2/2]

```
Umbrella2.Algorithms.Images.ImageStatistics.ImageStatistics (
    Image Image,
    double ZeroLevel,
    double StDev)
```

Creates an artificial set of statistics for an image.

Parameters

<i>Image</i>	Image.
<i>ZeroLevel</i>	Background level.
<i>StDev</i>	Standard deviation.

2.85.3 Member Function Documentation

GetRecords()

```
override List< MetadataRecord > Umbrella2.Algorithms.Images.ImageStatistics.GetRecords ()
```

StatisticsSolver()

```
delegate void Umbrella2.Algorithms.Images.ImageStatistics.StatisticsSolver (  
    Image Image,  
    out double ZeroLevel,  
    out double StDev)
```

Signature of the solver algorithm used by [ImageStatistics](#) to obtain the background and noise levels.

2.85.4 Member Data Documentation

Solver

```
StatisticsSolver Umbrella2.Algorithms.Images.ImageStatistics.Solver = BasicImstatSolver.BasicSolver  
[static], [private]
```

The computation function for solving image statistics.

StDev

```
readonly double Umbrella2.Algorithms.Images.ImageStatistics.StDev
```

Noise standard deviations.

ZeroLevel

```
readonly double Umbrella2.Algorithms.Images.ImageStatistics.ZeroLevel
```

Background level.

2.86 Umbrella2.IO.ImageTiming Class Reference

Holds the observation time information of the associated [Image](#).

Public Member Functions

- [ImageTiming](#) (DateTime HeaderStartOfExposure, TimeSpan ExposureInterval)
Instantiates a new object of [ImageTiming](#) type with the usual [FITS](#) assumptions.

Public Attributes

- readonly DateTime [HeaderTime](#)
Observation time of the image, as given in image propeerties.
- readonly TimeSpan [Exposure](#)
Duration of the image exposure.
- readonly DateTime [MidExposure](#)
Middle of exposure, as inferred from headers.

2.86.1 Detailed Description

Holds the observation time information of the associated [Image](#).

2.86.2 Constructor & Destructor Documentation

ImageTiming()

```
Umbrella2.IO.ImageTiming.ImageTiming (
    DateTime HeaderStartOfExposure,
    TimeSpan ExposureInterval)
```

Instantiates a new object of [ImageTiming](#) type with the usual [FITS](#) assumptions.

Parameters

<i>HeaderStartOfExposure</i>	Header time assumed start of exposure.
<i>ExposureInterval</i>	Duration of the image exposure.

2.86.3 Member Data Documentation

Exposure

```
readonly TimeSpan Umbrella2.IO.ImageTiming.Exposure
```

Duration of the image exposure.

HeaderTime

```
readonly DateTime Umbrella2.IO.ImageTiming.HeaderTime
```

Observation time of the image, as given in image properties.

MidExposure

```
readonly DateTime Umbrella2.IO.ImageTiming.MidExposure
```

Middle of exposure, as inferred from headers.

It might be difficult to get this right, due to lack of standardization.

2.87 Umbrella2.Utils.ImplicitReflection Class Reference

Static Public Member Functions

- static Dictionary< string, T > [GenerateEnumMap< T > \(\)](#)

2.87.1 Member Function Documentation

GenerateEnumMap< T >()

```
static Dictionary< string, T > Umbrella2.Utils.ImplicitReflection.GenerateEnumMap< T > ()  
[static]
```

Type Constraints

T: *Enum*

2.88 Umbrella2.PropertyModel.InsufficientInformationException Class Reference

Thrown when not enough types are available to compute a given property.

2.88.1 Detailed Description

Thrown when not enough types are available to compute a given property.

2.89 Umbrella2.IO.FITS.Formats.IntegerDataset Class Reference

Module for reading from and writing to floating-point [FITS](#) data arrays. Functions provide for converting memory-mapped file data to IEEE floating point.

Static Public Member Functions

- static unsafe void [Read8](#) (IntPtr Pointer, double[,] Data, int Hstart, int Hend, int Wstart, int Wend, int Stride)
- static unsafe void [Write8](#) (IntPtr Pointer, double[,] Data, int Stride)
- static unsafe void [Read16](#) (IntPtr Pointer, double[,] Data, int Hstart, int Hend, int Wstart, int Wend, int Stride)
- static unsafe void [Write16](#) (IntPtr Pointer, double[,] Data, int Stride)
- static unsafe void [Read32](#) (IntPtr Pointer, double[,] Data, int Hstart, int Hend, int Wstart, int Wend, int Stride)
- static unsafe void [Write32](#) (IntPtr Pointer, double[,] Data, int Stride)
- static unsafe void [Read64](#) (IntPtr Pointer, double[,] Data, int Hstart, int Hend, int Wstart, int Wend, int Stride)
- static unsafe void [Write64](#) (IntPtr Pointer, double[,] Data, int Stride)

2.89.1 Detailed Description

Module for reading from and writing to floating-point [FITS](#) data arrays. Functions provide for converting memory-mapped file data to IEEE floating point.

The BITPIX = 8 case is unsigned, other BITPIX of integer type are signed. This is according to [FITS](#) standard v4.

2.89.2 Member Function Documentation

Read16()

```
static unsafe void Umbrella2.IO.FITS.Formats.IntegerDataset.Read16 (  
    IntPtr Pointer,  
    double Data[,],  
    int Hstart,  
    int Hend,  
    int Wstart,  
    int Wend,  
    int Stride) [static]
```

Read32()

```
static unsafe void Umbrella2.IO.FITS.Formats.IntegerDataset.Read32 (  
    IntPtr Pointer,  
    double Data[,],  
    int Hstart,  
    int Hend,  
    int Wstart,  
    int Wend,  
    int Stride) [static]
```

Read64()

```
static unsafe void Umbrella2.IO.FITS.Formats.IntegerDataset.Read64 (  
    IntPtr Pointer,  
    double Data[,],  
    int Hstart,  
    int Hend,  
    int Wstart,  
    int Wend,  
    int Stride) [static]
```

Read8()

```
static unsafe void Umbrella2.IO.FITS.Formats.IntegerDataset.Read8 (  
    IntPtr Pointer,  
    double Data[,],  
    int Hstart,  
    int Hend,  
    int Wstart,  
    int Wend,  
    int Stride) [static]
```

Write16()

```
static unsafe void Umbrella2.IO.FITS.Formats.IntegerDataset.Write16 (  
    IntPtr Pointer,  
    double Data[,],  
    int Stride) [static]
```

Write32()

```
static unsafe void Umbrella2.IO.FITS.Formats.IntegerDataset.Write32 (  
    IntPtr Pointer,  
    double Data[],  
    int Stride) [static]
```

Write64()

```
static unsafe void Umbrella2.IO.FITS.Formats.IntegerDataset.Write64 (  
    IntPtr Pointer,  
    double Data[],  
    int Stride) [static]
```

Write8()

```
static unsafe void Umbrella2.IO.FITS.Formats.IntegerDataset.Write8 (  
    IntPtr Pointer,  
    double Data[],  
    int Stride) [static]
```

2.90 Umbrella2.Algorithms.Detection.DotDetector.IntPoint Struct Reference

Integer lattice point.

Package Attributes

- [int X](#)
- [int Y](#)

2.90.1 Detailed Description

Integer lattice point.

2.90.2 Member Data Documentation

X

```
int Umbrella2.Algorithms.Detection.DotDetector.IntPoint.X [package]
```

Y

```
int Umbrella2.Algorithms.Detection.DotDetector.IntPoint.Y [package]
```

2.91 Umbrella2.Algorithms.Images.LineAnalyzer.IntPoint Struct Reference

Pixel on the image.

Package Attributes

- [int X](#)
- [int Y](#)

2.91.1 Detailed Description

Pixel on the image.

2.91.2 Member Data Documentation

X

```
int Umbrella2.Algorithms.Images.LineAnalyzer.IntPoint.X [package]
```

Y

```
int Umbrella2.Algorithms.Images.LineAnalyzer.IntPoint.Y [package]
```

2.92 Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.InvalidFieldException Class Reference

Represents an invalid [ObsInstance](#) field.

Public Types

- enum [FieldType](#) {
[PublishingNote](#) , [MagnitudeBand](#) , [Note2](#) , [ObjectDesignation](#) ,
[Time](#) , [RADEC](#) , [Magnitude](#) , [ObservatoryCode](#) ,
[DetectionAsterisk](#) , [ObsTime](#) , [Coordinates](#) , [PackedMPN](#) }

Represents the fields that could have failed.

Public Member Functions

- [InvalidFieldException](#) ([FieldType](#) type)

Properties

- [FieldType](#) [ExceptionType](#) [get]

The field that failed.

2.92.1 Detailed Description

Represents an invalid [ObsInstance](#) field.

2.92.2 Member Enumeration Documentation

FieldType

```
enum Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.InvalidFieldException.FieldType
```

Represents the fields that could have failed.

Enumerator

PublishingNote	
MagnitudeBand	
Note2	
ObjectDesignation	
Time	
RADEC	
Magnitude	
ObservatoryCode	
DetectionAsterisk	
ObsTime	
Coordinates	
PackedMPN	

2.92.3 Constructor & Destructor Documentation

InvalidFieldException()

```
Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.InvalidFieldException.InvalidFieldException
(
    FieldType type)
```

2.92.4 Property Documentation

ExceptionType

```
FieldType Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.InvalidFieldException.Exception↔
Type [get]
```

The field that failed.

2.93 Umbrella2.PropertyModel.IObjectPropertyViewer< T, U > Interface Template Reference

Interface for components that allow the user to view and modify a certain object property.

Public Member Functions

- void [ViewObject](#) (T obj)
- void [RegisterModificationCallback](#) (Action< U > Callback)

2.93.1 Detailed Description

Interface for components that allow the user to view and modify a certain object property.

See also

[IObjectViewer<T>](#)

Template Parameters

<i>T</i>	Type of the object whose property can be viewed.
<i>U</i>	Type of the property.

Type Constraints

U : *IExtensionProperty*

2.93.2 Member Function Documentation

RegisterModificationCallback()

```
void Umbrella2.PropertyModel.IObjectPropertyViewer< T, U >.RegisterModificationCallback (
    Action< U > Callback)
```

ViewObject()

```
void Umbrella2.PropertyModel.IObjectPropertyViewer< T, U >.ViewObject (
    T obj)
```

2.94 Umbrella2.PropertyModel.IObjectViewer< T > Interface Template Reference

Interface for components that allow the user to view and modify object properties.

Public Member Functions

- void [ViewObject](#) (T obj)
On call, display object.
- void [RegisterModificationCallback](#) (Action< T > Callback)
Register a callback for replacing the object.

2.94.1 Detailed Description

Interface for components that allow the user to view and modify object properties.

Template Parameters

<i>T</i>	Type of the object that can be viewed.
----------	--

2.94.2 Member Function Documentation

RegisterModificationCallback()

```
void Umbrella2.PropertyModel.IObjectViewer< T >.RegisterModificationCallback (
    Action< T > Callback)
```

Register a callback for replacing the object.

Parameters

<i>Callback</i>	Callback on object change.
-----------------	----------------------------

ViewObject()

```
void Umbrella2.PropertyModel.IObjectViewer< T >.ViewObject (
    T obj)
```

On call, display object.

Parameters

<i>obj</i>	Object to be shown.
------------	---------------------

2.95 Umbrella2.Pipeline.ExtraIO.Ipef.IpefDetection Class Reference

Represents a single detection, roughly equivalent to an MPC observation.

Public Attributes

- int [DetectionId](#)
Detection ID (number). Should be unique for a given tracklet.
- [IdentificationGroup Identification](#)
Information about which asteroid was observed (including from where).
- [LocationGroup Location](#)
Detailed information on observing location (particularly for roving observers).
- [ObservationGroup Observation](#)
Astrometry of the observation.
- [PhotometryGroup\[\] Photometry](#)
Photometry of the observation.
- [PrecisionGroup Precision](#)
Information on the precision of measurements, particularly for older results.
- [ResidualsGroup Residuals](#)
Provides information on residuals from fitting with a known (orbital and photometric) object/model.
- [IpefDispatchGroup ExtendedProperties](#)
Provides user-defined properties for the detection.

2.95.1 Detailed Description

Represents a single detection, roughly equivalent to an MPC observation.

2.95.2 Member Data Documentation

DetectionId

`int Umbrella2.Pipeline.ExtraIO.Ipef.IpefDetection.DetectionId`

Detection ID (number). Should be unique for a given tracklet.

ExtendedProperties

`IpefDispatchGroup Umbrella2.Pipeline.ExtraIO.Ipef.IpefDetection.ExtendedProperties`

Provides user-defined properties for the detection.

Identification

`IdentificationGroup Umbrella2.Pipeline.ExtraIO.Ipef.IpefDetection.Identification`

Information about which asteroid was observed (including from where).

Location

`LocationGroup Umbrella2.Pipeline.ExtraIO.Ipef.IpefDetection.Location`

Detailed information on observing location (particularly for roving observers).

Observation

`ObservationGroup Umbrella2.Pipeline.ExtraIO.Ipef.IpefDetection.Observation`

Astrometry of the observation.

Photometry

`PhotometryGroup [] Umbrella2.Pipeline.ExtraIO.Ipef.IpefDetection.Photometry`

Photometry of the observation.

Precision

`PrecisionGroup Umbrella2.Pipeline.ExtraIO.Ipef.IpefDetection.Precision`

Information on the precision of measurements, particularly for older results.

Residuals

`ResidualsGroup` Umbrella2.Pipeline.ExtraIO.Ipef.IpefDetection.Residuals

Provides information on residuals from fitting with a known (orbital and photometric) object/model.

2.96 Umbrella2.Pipeline.ExtraIO.Ipef.IpefDetectionData Class Reference

Represents an instance of the output of a Umbrella detection pipeline in inter-pipeline exchange format.

Public Attributes

- [ObservationContext](#) Context
- [IpefTracklet\[\]](#) Tracklets

2.96.1 Detailed Description

Represents an instance of the output of a Umbrella detection pipeline in inter-pipeline exchange format.

2.96.2 Member Data Documentation

Context

`ObservationContext` Umbrella2.Pipeline.ExtraIO.Ipef.IpefDetectionData.Context

Tracklets

`IpefTracklet` [] Umbrella2.Pipeline.ExtraIO.Ipef.IpefDetectionData.Tracklets

2.97 Umbrella2.Pipeline.ExtraIO.Ipef.IpefDispatchAttribute Class Reference

Represents a point of dispatch for extension-defined [Ipef](#) groups.

Public Member Functions

- [IpefDispatchAttribute](#) (string groupName)
Marks a field as a dispatch group. This field must be of a type that contains a single field, which should be a `System.Collections.Generic.Dictionary<TKey, TValue>` from `System.Type` to object, which is the dispatch table.

Public Attributes

- readonly string [GroupName](#)
Name of the group as it should appear in the XML file.

2.97.1 Detailed Description

Represents a point of dispatch for extension-defined [Ipef](#) groups.

2.97.2 Constructor & Destructor Documentation

IpefDispatchAttribute()

```
Umbrella2.Pipeline.ExtraIO.Ipef.IpefDispatchAttribute.IpefDispatchAttribute (
    string groupName)
```

Marks a field as a dispatch group. This field must be of a type that contains a single field, which should be a `System.Collections.Generic.Dictionary<TKey, TValue>` from `System.Type` to object, which is the dispatch table.

Parameters

<i>groupName</i>	Name of the group containing dispatched groups, as shown in XML.
------------------	--

2.97.3 Member Data Documentation

GroupName

```
readonly string Umbrella2.Pipeline.ExtraIO.Ipef.IpefDispatchAttribute.GroupName
```

Name of the group as it should appear in the XML file.

2.98 Umbrella2.Pipeline.ExtraIO.Ipef.IpefDispatchGroup Class Reference

Represents sets of user-extensible [Ipef](#) groups. This structure ensures the extension groups do not clash with the main definitions.

Public Member Functions

- `bool TryGet< T >` (out T value)
Try to retrieve the extension property of type .

Public Attributes

- `System.Collections.Generic.Dictionary< System.Type, object >` [PropertyList](#)
Represents user-extensible [Ipef](#) groups. These are dynamically dispatched.

2.98.1 Detailed Description

Represents sets of user-extensible [Ipef](#) groups. This structure ensures the extension groups do not clash with the main definitions.

2.98.2 Member Function Documentation

TryGet< T >()

```
bool Umbrella2.Pipeline.ExtraIO.Ipef.IpefDispatchGroup.TryGet< T > (
    out T value)
```

Try to retrieve the extension property of type .

Parameters

<i>value</i>	Property value.
--------------	-----------------

Template Parameters

<i>T</i>	Property type to extract.
----------	---------------------------

Returns

`true` if there is an extension property of specified type, `false` otherwise.

2.98.3 Member Data Documentation**PropertyList**

`System.Collections.Generic.Dictionary<System.Type, object> Umbrella2.Pipeline.ExtraIO.Ipef.IpefDispatchGroup.PropertyList`

Represents user-extensible [Ipef](#) groups. These are dynamically dispatched.

2.99 Umbrella2.Pipeline.ExtraIO.Ipef.IpefGroupRegistry Class Reference

List of [Ipef](#) extensions for dynamic dispatch.

Public Member Functions

- void [LoadFromTypeList](#) (Type[] TypeArray)
Lloads [Ipef](#) groups from a list of dotnet types.

Static Public Member Functions

- static bool [TryGetGroupType](#) (string groupName, out Type type)
Retrieves the type of a group from its name.

Protected Member Functions

- [IpefGroupRegistry Register](#) ()
Singleton registration.

Private Attributes

- readonly Dictionary< string, Type > [GroupTypes](#) = new Dictionary<string, Type>()

Static Private Attributes

- static readonly `IpefGroupRegistry Instance` = new `IpefGroupRegistry().Register()`
The singleton instance.

2.99.1 Detailed Description

List of `Ipef` extensions for dynamic dispatch.

2.99.2 Member Function Documentation

LoadFromTypeList()

```
void Umbrella2.Pipeline.ExtraIO.Ipef.IpefGroupRegistry.LoadFromTypeList (
    Type[] TypeArray)
```

Loads `Ipef` groups from a list of dotnet types.

Parameters

<code>TypeArray</code>	List of types.
------------------------	----------------

Implements `Umbrella2.Plugins.IPluggableElementLoader`.

Register()

```
IpefGroupRegistry Umbrella2.Pipeline.ExtraIO.Ipef.IpefGroupRegistry.Register () [protected]
```

Singleton registration.

Returns

The instance.

TryGetGroupType()

```
static bool Umbrella2.Pipeline.ExtraIO.Ipef.IpefGroupRegistry.TryGetGroupType (
    string groupName,
    out Type type) [static]
```

Retrieves the type of a group from its name.

Parameters

<code>groupName</code>	Name of the group, as written to the <code>Ipef</code> file.
<code>type</code>	Output type.

Returns

Same as `Dictionary<T,V>.TryGetValue`.

2.99.3 Member Data Documentation

GroupTypes

```
readonly Dictionary<string, Type> Umbrella2.Pipeline.ExtraIO.Ipef.IpefGroupRegistry.GroupTypes  
= new Dictionary<string, Type>() [private]
```

Instance

```
readonly IpefGroupRegistry Umbrella2.Pipeline.ExtraIO.Ipef.IpefGroupRegistry.Instance = new  
IpefGroupRegistry().Register() [static], [private]
```

The singleton instance.

2.100 Umbrella2.Pipeline.ExtraIO.Ipef.IpefImageInfo Class Reference

Metadata for a single reduced image. Work in progress.

2.100.1 Detailed Description

Metadata for a single reduced image. Work in progress.

2.101 Umbrella2.Pipeline.ExtraIO.Ipef.IpefReducedImageMetadata Class Reference

Provides metadata about images reduced, which may be used in downstream pipelines. Work in progress.

Private Attributes

- [IpefImageInfo\[\] Images](#)

2.101.1 Detailed Description

Provides metadata about images reduced, which may be used in downstream pipelines. Work in progress.

2.101.2 Member Data Documentation

Images

```
IpefImageInfo [] Umbrella2.Pipeline.ExtraIO.Ipef.IpefReducedImageMetadata.Images [private]
```

2.102 Umbrella2.Pipeline.ExtraIO.Ipef.IpefTracklet Class Reference

Represents a tracklet (a group of observations of the presumed same object).

Public Attributes

- int [TrackletId](#)
Tracklet ID. Should be unique for a given report.
- [IpefDetection\[\]](#) [Detections](#)
Detections associated with the tracklet.
- [TrackletStamps](#) [StampData](#)
Allows matching the stamps with a given tracklet.
- [IpefDispatchGroup](#) [ExtendedProperties](#)
Provides user-defined properties for the tracklet.

2.102.1 Detailed Description

Represents a tracklet (a group of observations of the presumed same object).

2.102.2 Member Data Documentation

Detections

[IpefDetection](#) [] `Umbrella2.Pipeline.ExtraIO.Ipef.IpefTracklet.Detections`

Detections associated with the tracklet.

ExtendedProperties

[IpefDispatchGroup](#) `Umbrella2.Pipeline.ExtraIO.Ipef.IpefTracklet.ExtendedProperties`

Provides user-defined properties for the tracklet.

StampData

[TrackletStamps](#) `Umbrella2.Pipeline.ExtraIO.Ipef.IpefTracklet.StampData`

Allows matching the stamps with a given tracklet.

TrackletId

`int Umbrella2.Pipeline.ExtraIO.Ipef.IpefTracklet.TrackletId`

[Tracklet](#) ID. Should be unique for a given report.

2.103 Umbrella2.Pipeline.ExtraIO.Ipef.IpefXml Class Reference

Converts in-memory representations of [Ipef](#) to the disk format (XML).

Static Public Member Functions

- static XDocument [GenerateXML< T >](#) (T document)
Generates the XML corresponding to the input IPEF dataset type.
- static T [ReadXML< T >](#) (XDocument document)
Reads an IPEF dataset from the input XML.

Static Private Member Functions

- static void [DispatchGroupReadXML](#) (Type rootType, object rootInstance, XElement ancestor)
- static void [FillGroupWithXML](#) (Type rootType, object rootInstance, XElement ancestor)
Fills the [Umbrella2 Ipef](#) group representations from an XML document.
- static void [DispatchGroupWriteXML](#) (Type rootType, object rootInstance, XElement ancestor)
- static void [FillXmlWithGroup](#) (Type rootType, object rootInstance, XElement ancestor)
Fills the generated [Ipef](#) XML with a group.

2.103.1 Detailed Description

Converts in-memory representations of [Ipef](#) to the disk format (XML).

2.103.2 Member Function Documentation

DispatchGroupReadXML()

```
static void Umbrella2.Pipeline.ExtraIO.Ipef.IpefXml.DispatchGroupReadXML (
    Type rootType,
    object rootInstance,
    XElement ancestor) [static], [private]
```

DispatchGroupWriteXML()

```
static void Umbrella2.Pipeline.ExtraIO.Ipef.IpefXml.DispatchGroupWriteXML (
    Type rootType,
    object rootInstance,
    XElement ancestor) [static], [private]
```

FillGroupWithXML()

```
static void Umbrella2.Pipeline.ExtraIO.Ipef.IpefXml.FillGroupWithXML (
    Type rootType,
    object rootInstance,
    XElement ancestor) [static], [private]
```

Fills the [Umbrella2 Ipef](#) group representations from an XML document.

Parameters

<i>rootType</i>	Type of the target root object.
<i>rootInstance</i>	The Ipef structure to fill.
<i>ancestor</i>	XML element containing the group data.

FillXmlWithGroup()

```
static void Umbrella2.Pipeline.ExtraIO.Ipef.IpefXml.FillXmlWithGroup (
    Type rootType,
    object rootInstance,
    XElement ancestor) [static], [private]
```

Fills the generated [Ipef](#) XML with a group.

Parameters

<i>rootType</i>	Type of the root object.
<i>rootInstance</i>	Instance to be transformed to XML.
<i>ancestor</i>	Ancestor element for this group.

GenerateXML< T >()

```
static XDocument Umbrella2.Pipeline.ExtraIO.Ipef.IpefXml.GenerateXML< T > (
    T document) [static]
```

Generates the XML corresponding to the input IPEF dataset type.

Parameters

<i>document</i>	Report to convert to XML.
-----------------	---------------------------

Template Parameters

<i>T</i>	Type of the IPEF dataset
----------	--------------------------

Returns

An XML document with the dataset.

Type Constraints

***T* : class**

***T* : new()**

ReadXML< T >()

```
static T Umbrella2.Pipeline.ExtraIO.Ipef.IpefXml.ReadXML< T > (
    XDocument document) [static]
```

Reads an IPEF dataset from the input XML.

Parameters

<i>document</i>	XML document containing the IPEF dataset.
-----------------	---

Returns

The IPEF dataset, represented by the internal structures.

Type Constraints

***T* : class**

***T* : new()**

2.104 Umbrella2.Plugins.IPluggableElementLoader Interface Reference

Represents an [Umbrella2](#) plugin holder element which can load plugin elements.

Public Member Functions

- void [LoadFromTypeList](#) (Type[] TypeArray)
Scans and loads plugins from given types.

2.104.1 Detailed Description

Represents an [Umbrella2](#) plugin holder element which can load plugin elements.

2.104.2 Member Function Documentation

LoadFromTypeList()

```
void Umbrella2.Plugins.IPluggableElementLoader.LoadFromTypeList (  
    Type[] TypeArray)
```

Scans and loads plugins from given types.

Parameters

<i>TypeArray</i>	List of types to scan.
------------------	------------------------

Implemented in [Umbrella2.Pipeline.ExtraIO.Ipef.IpefGroupRegistry](#), and [Umbrella2.WCS.Projections.WCSProjections](#).

2.105 Umbrella2.PropertyModel.IPropertyCalculator< T, U > Interface Template Reference

Represents a method that can compute an extension property of a given object from its other properties.

Public Member Functions

- Type[][] [GetRequiredProperties](#) ()
Retrieves a list of lists of properties necessary to compute the new property; each list being sufficient to compute the property.
- T [ComputeProperty](#) (U Object)
Computes the property T of the specified object. If the required types are not available, it should throw [InsufficientInformationException](#).

2.105.1 Detailed Description

Represents a method that can compute an extension property of a given object from its other properties.

Template Parameters

<i>T</i>	Type of the property to compute.
<i>U</i>	Type of the object to compute the properties on.

2.105.2 Member Function Documentation

ComputeProperty()

```
T Umbrella2.PropertyModel.IPropertyCalculator< T, U >.ComputeProperty (
    U Object)
```

Computes the property *T* of the specified object. If the required types are not available, it should throw [InsufficientInformationException](#).

Parameters

<i>Object</i>	Object on which to compute the property.
---------------	--

Returns

The computed property.

GetRequiredProperties()

```
Type[][] Umbrella2.PropertyModel.IPropertyCalculator< T, U >.GetRequiredProperties ()
```

Retrieves a list of lists of properties necessary to compute the new property; each list being sufficient to compute the property.

Returns

An array of types that are required for computing the object.

2.106 Umbrella2.Algorithms.Filtering.ITrackletFilter Interface Reference

Public Member Functions

- bool [Filter](#) ([Tracklet](#) Input)

2.106.1 Member Function Documentation

Filter()

```
bool Umbrella2.Algorithms.Filtering.ITrackletFilter.Filter (
    Tracklet Input)
```

Implemented in [Umbrella2.Algorithms.Filtering.LinearityTest](#).

2.107 Umbrella2.Pipeline.ExtraIO.Vizier.IVizierParser Interface Reference

Common interface for [VizieR](#) parsers.

Public Member Functions

- List< [VizieR.StarInfo](#) > [ParseVizierResults](#) (string Data)
Parses the [VizieR](#) data.

Properties

- string [QueryFormat](#) [get]
Format to request from [VizieR](#) server.

2.107.1 Detailed Description

Common interface for [VizieR](#) parsers.

2.107.2 Member Function Documentation

ParseVizierResults()

```
List< VizieR.StarInfo > Umbrella2.Pipeline.ExtraIO.Vizier.IVizierParser.ParseVizierResults (
    string Data)
```

Parses the [VizieR](#) data.

Returns

The list of known stars.

Parameters

<i>Data</i>	Data returned by the VizieR server.
-------------	---

Implemented in [Umbrella2.Pipeline.ExtraIO.Vizier.TsvParser](#), and [Umbrella2.Pipeline.ExtraIO.Vizier.VotableParser](#).

2.107.3 Property Documentation

QueryFormat

```
string Umbrella2.Pipeline.ExtraIO.Vizier.IVizierParser.QueryFormat [get]
```

Format to request from [VizieR](#) server.

Implemented in [Umbrella2.Pipeline.ExtraIO.Vizier.TsvParser](#), and [Umbrella2.Pipeline.ExtraIO.Vizier.VotableParser](#).

2.108 Umbrella2.Pipeline.ExtraIO.IVotableContainer Interface Reference

Properties

- string [Description](#) [get]

2.108.1 Property Documentation

Description

string Umbrella2.Pipeline.ExtraIO.IVotableContainer.Description [get]

Implemented in [Umbrella2.Pipeline.ExtraIO.VOTableMini](#).

2.109 Umbrella2.WCS.IWCSPProjection Interface Reference

Public Member Functions

- [EquatorialPoint](#) [GetEquatorialPoint](#) ([PixelPoint](#) Point)
- [EquatorialPoint\[\]](#) [GetEquatorialPoints](#) ([PixelPoint\[\]](#) Points)
- List< [EquatorialPoint](#) > [GetEquatorialPoints](#) (IEnumerable< [PixelPoint](#) > Points)
- double [GetEstimatedWCSCChainDerivative](#) ()
- [PixelPoint](#) [GetPixelPoint](#) ([EquatorialPoint](#) Point)
- [PixelPoint\[\]](#) [GetPixelPoints](#) ([EquatorialPoint\[\]](#) Points)
- List< [PixelPoint](#) > [GetPixelPoints](#) (IEnumerable< [EquatorialPoint](#) > Points)
- [EquatorialVelocity](#) [GetEquatorialVelocity](#) ([PixelVelocity](#) PV)
- [PixelVelocity](#) [GetPixelVelocity](#) ([EquatorialVelocity](#) EV)

2.109.1 Member Function Documentation

[GetEquatorialPoint\(\)](#)

[EquatorialPoint](#) Umbrella2.WCS.IWCSPProjection.GetEquatorialPoint (
[PixelPoint](#) Point)

Implemented in [Umbrella2.WCS.WCSViaProjection](#).

[GetEquatorialPoints\(\)](#) [1/2]

List< [EquatorialPoint](#) > Umbrella2.WCS.IWCSPProjection.GetEquatorialPoints (
 IEnumerable< [PixelPoint](#) > Points)

Implemented in [Umbrella2.WCS.WCSViaProjection](#).

[GetEquatorialPoints\(\)](#) [2/2]

[EquatorialPoint\[\]](#) Umbrella2.WCS.IWCSPProjection.GetEquatorialPoints (
[PixelPoint\[\]](#) Points)

Implemented in [Umbrella2.WCS.WCSViaProjection](#).

GetEquatorialVelocity()

```
EquatorialVelocity Umbrella2.WCS.IWCSProjection.GetEquatorialVelocity (
    PixelVelocity PV)
```

Implemented in [Umbrella2.WCS.WCSViaProjection](#).

GetEstimatedWCSChainDerivative()

```
double Umbrella2.WCS.IWCSProjection.GetEstimatedWCSChainDerivative ()
```

Implemented in [Umbrella2.WCS.WCSViaProjection](#).

GetPixelPoint()

```
PixelPoint Umbrella2.WCS.IWCSProjection.GetPixelPoint (
    EquatorialPoint Point)
```

Implemented in [Umbrella2.WCS.WCSViaProjection](#).

GetPixelPoints() [1/2]

```
PixelPoint[] Umbrella2.WCS.IWCSProjection.GetPixelPoints (
    EquatorialPoint[] Points)
```

Implemented in [Umbrella2.WCS.WCSViaProjection](#).

GetPixelPoints() [2/2]

```
List< PixelPoint > Umbrella2.WCS.IWCSProjection.GetPixelPoints (
    IEnumerable< EquatorialPoint > Points)
```

Implemented in [Umbrella2.WCS.WCSViaProjection](#).

GetPixelVelocity()

```
PixelVelocity Umbrella2.WCS.IWCSProjection.GetPixelVelocity (
    EquatorialVelocity EV)
```

Implemented in [Umbrella2.WCS.WCSViaProjection](#).

2.110 Umbrella2.IO.FITS.KeywordRecord Struct Reference

[FITS](#) Keyword Record. Raw form.

Public Member Functions

- [KeywordRecord](#) (byte[] Raw)

Public Attributes

- readonly string [Name](#)
- readonly string [Data](#)
- readonly bool [HasEqual](#)

Static Package Functions

- static [MetadataRecord Elevate](#) ([KeywordRecord](#) kwr)

2.110.1 Detailed Description

[FITS](#) Keyword Record. Raw form.

2.110.2 Constructor & Destructor Documentation

KeywordRecord()

```
Umbrella2.IO.FITS.KeywordRecord.KeywordRecord (  
    byte[] Raw)
```

2.110.3 Member Function Documentation

Elevate()

```
static MetadataRecord Umbrella2.IO.FITS.KeywordRecord.Elevate (  
    KeywordRecord kwr) [static], [package]
```

2.110.4 Member Data Documentation

Data

```
readonly string Umbrella2.IO.FITS.KeywordRecord.Data
```

HasEqual

```
readonly bool Umbrella2.IO.FITS.KeywordRecord.HasEqual
```

Name

readonly string Umbrella2.IO.FITS.KeywordRecord.Name

2.111 Umbrella2.Algorithms.Images.LineAnalyzer Class Reference

Algorithm that analyzes line using a hysteresis connected component algorithm for detecting luminous blobs and merges the blobs into line segments.

Classes

- struct [DetectionBlob](#)
Represents a detected light blob.
- struct [DetectionSegment](#)
A candidate line segment detection.
- struct [IntPoint](#)
Pixel on the image.
- class [LineDetection](#)
A processed line segment detection.

Static Package Functions

- static List< [LineDetection](#) > [AnalyzeLine](#) (double[,] Input, bool[,] AnalyzeMask, int Height, int Width, double Rho, double Theta, double HighTh, double LowTh, int MaxIgnore, int ScanWidth, int OX, int OY)
Scans a line on the image for line segments using a hysteresis connected component algorithm.

Static Private Member Functions

- static [DetectionBlob](#) [BitmapFill](#) (double[,] Input, [IntPoint](#) StartPoint, bool[,] Mask, double LowThreshold, double Angle)
Gets the connected component starting from a point on an image.
- static [LineDetection](#) [MergeBlobs](#) ([DetectionSegment](#) segment, double[,] Input, int OX, int OY)
Merges line segment blobs (connected components) in one [LineDetection](#).

2.111.1 Detailed Description

Algorithm that analyzes line using a hysteresis connected component algorithm for detecting luminous blobs and merges the blobs into line segments.

2.111.2 Member Function Documentation

AnalyzeLine()

```
static List< LineDetection > Umbrella2.Algorithms.Images.LineAnalyzer.AnalyzeLine (
    double Input[,],
    bool AnalyzeMask[,],
    int Height,
    int Width,
    double Rho,
    double Theta,
    double HighTh,
    double LowTh,
    int MaxIgnore,
    int ScanWidth,
    int OX,
    int OY) [static], [package]
```

Scans a line on the image for line segments using a hysteresis connected component algorithm.

Parameters

<i>Input</i>	Input data.
<i>AnalyzeMask</i>	Mask for marking visited pixels.
<i>Height</i>	Data height.
<i>Width</i>	Data width.
<i>Rho</i>	Distance from origin to line.
<i>Theta</i>	Line angle.
<i>HighTh</i>	Upper hysteresis threshold.
<i>LowTh</i>	Lower hysteresis threshold.
<i>MaxIgnore</i>	Maximum interblob distance.
<i>ScanWidth</i>	Width of the scanned area.
<i>OX</i>	Image data origin X coordinate.
<i>OY</i>	Image data origin Y coordinate.

Returns

A list of line segment detections.

BitmapFill()

```
static DetectionBlob Umbrella2.Algorithms.Images.LineAnalyzer.BitmapFill (
    double Input[,],
    IntPoint StartPoint,
    bool Mask[,],
    double LowThreshold,
    double Angle) [static], [private]
```

Gets the connected component starting from a point on an image.

Parameters

<i>Input</i>	Input Image.
<i>StartPoint</i>	Starting point.
<i>Mask</i>	Already processed components mask.
<i>LowThreshold</i>	Threshold for component discrimination.
<i>Angle</i>	Angle of the line; used for distance projections.

Returns

The connected component blob.

MergeBlobs()

```
static LineDetection Umbrella2.Algorithms.Images.LineAnalyzer.MergeBlobs (
    DetectionSegment segment,
    double Input[,],
    int OX,
    int OY) [static], [private]
```

Merges line segment blobs (connected components) in one [LineDetection](#).

Parameters

<i>segment</i>	Detected blobs.
<i>Input</i>	Input image.
<i>OX</i>	Delta between the data array and actual position, X component.
<i>OY</i>	Delta between the data array and actual position, Y component.

Returns

A [LineDetection](#) from the blobs.

2.112 Umbrella2.Algorithms.Filtering.LinearityTest Class Reference

Linearity filter for tracklets.

Public Member Functions

- bool [Filter](#) ([Tracklet](#) Input)

Static Public Member Functions

- static implicit [operator Predicate< Tracklet >](#) ([LinearityTest](#) f)
Implicitly converts itself to the signature of a filter.

Private Member Functions

- double [ComputePearsonR](#) ([Tracklet](#) Input)

Static Private Attributes

- const double [LineRsquared](#) = 0.8
- const double [TimeRsquared](#) = 0.8
- const double [IndividualRsquared](#) = 0.5

2.112.1 Detailed Description

Linearity filter for tracklets.

2.112.2 Member Function Documentation

ComputePearsonR()

```
double Umbrella2.Algorithms.Filtering.LinearityTest.ComputePearsonR (
    Tracklet Input) [private]
```

Filter()

```
bool Umbrella2.Algorithms.Filtering.LinearityTest.Filter (
    Tracklet Input)
```

Implements [Umbrella2.Algorithms.Filtering.ITrackletFilter](#).

operator Predicate< [Tracklet](#) >()

```
static implicit Umbrella2.Algorithms.Filtering.LinearityTest.operator Predicate< Tracklet > (
    LinearityTest f) [static]
```

Implicitly converts itself to the signature of a filter.

Parameters

<i>f</i>	Instance to convert to a filter.
----------	----------------------------------

2.112.3 Member Data Documentation

IndividualRsquared

```
const double Umbrella2.Algorithms.Filtering.LinearityTest.IndividualRsquared = 0.5 [static],
[private]
```

LineRsquared

```
const double Umbrella2.Algorithms.Filtering.LinearityTest.LineRsquared = 0.8 [static], [private]
```

TimeRsquared

```
const double Umbrella2.Algorithms.Filtering.LinearityTest.TimeRsquared = 0.8 [static], [private]
```

2.113 Umbrella2.Algorithms.Filtering.LinearityThresholdFilter Class Reference

Checks that the detection is thin enough on the semiminor axis.

Public Member Functions

- bool [Filter](#) ([ImageDetection](#) Input)

Static Public Member Functions

- static implicit [operator Predicate< ImageDetection >](#) ([LinearityThresholdFilter](#) f)

Public Attributes

- double [MaxLineThickness](#)
Maximum average thickness of the detection.

Private Member Functions

- double [ComputeWidth](#) ([ImageDetection](#) Input)

2.113.1 Detailed Description

Checks that the detection is thin enough on the semiminor axis.

2.113.2 Member Function Documentation

ComputeWidth()

```
double Umbrella2.Algorithms.Filtering.LinearityThresholdFilter.ComputeWidth (  
    ImageDetection Input) [private]
```

Filter()

```
bool Umbrella2.Algorithms.Filtering.LinearityThresholdFilter.Filter (
    ImageDetection Input)
```

Implements [Umbrella2.Algorithms.Filtering.IImageDetectionFilter](#).

operator Predicate< ImageDetection >()

```
static implicit Umbrella2.Algorithms.Filtering.LinearityThresholdFilter.operator Predicate<
ImageDetection > (
    LinearityThresholdFilter f) [static]
```

2.113.3 Member Data Documentation**MaxLineThickness**

```
double Umbrella2.Algorithms.Filtering.LinearityThresholdFilter.MaxLineThickness
```

Maximum average thickness of the detection.

2.114 Umbrella2.Algorithms.Misc.LinearRegression Class Reference

Provides linear regression functions.

Classes

- struct [LinearRegressionParameters](#)
The parameters obtained from a linear regression.

Static Public Member Functions

- static [LinearRegressionParameters ComputeLinearRegression](#) (double[] X, double[] Y)
Fits a line to a collection of points.
- static [LinearRegressionParameters ComputeLinearRegression](#) (IEnumerable< [PixelPoint](#) > Points)
Fits a line to a collection of points.

Static Private Member Functions

- static [LinearRegressionParameters LinearRegressionCore](#) (double sumX, double sumY, double sumCodev, double sumXSq, double sumYSq, int Length)
Common core for computing the linear regression of a set of points.

2.114.1 Detailed Description

Provides linear regression functions.

2.114.2 Member Function Documentation

ComputeLinearRegression() [1/2]

```
static LinearRegressionParameters Umbrella2.Algorithms.Misc.LinearRegression.ComputeLinear↵  
Regression (  
    double[] X,  
    double[] Y) [static]
```

Fits a line to a collection of points.

Parameters

<i>X</i>	The x-axis values.
<i>Y</i>	The y-axis values.

Returns

Regression parameters.

ComputeLinearRegression() [2/2]

```
static LinearRegressionParameters Umbrella2.Algorithms.Misc.LinearRegression.ComputeLinear↵
Regression (
    IEnumerable< PixelPoint > Points) [static]
```

Fits a line to a collection of points.

Parameters

<i>Points</i>	Input data.
---------------	-------------

Returns

Regression parameters.

LinearRegressionCore()

```
static LinearRegressionParameters Umbrella2.Algorithms.Misc.LinearRegression.LinearRegression↵
Core (
    double sumX,
    double sumY,
    double sumCodev,
    double sumXSq,
    double sumYSq,
    int Length) [static], [private]
```

Common core for computing the linear regression of a set of points.

2.115 Umbrella2.Algorithms.Misc.LinearRegression.LinearRegressionParameters Struct Reference

The parameters obtained from a linear regression.

Public Attributes

- double [PearsonR](#)
The Pearson R coefficient.
- double [Slope](#)
Slope of the regression line.
- double [Intercept](#)
Intercept of the regression line.

2.115.1 Detailed Description

The parameters obtained from a linear regression.

2.115.2 Member Data Documentation

Intercept

```
double Umbrella2.Algorithms.Misc.LinearRegression.LinearRegressionParameters.Intercept
```

Intercept of the regression line.

PearsonR

```
double Umbrella2.Algorithms.Misc.LinearRegression.LinearRegressionParameters.PearsonR
```

The Pearson R coefficient.

Slope

```
double Umbrella2.Algorithms.Misc.LinearRegression.LinearRegressionParameters.Slope
```

Slope of the regression line.

2.116 Umbrella2.Visualizer.WinForms.LinearScaler Class Reference

Algorithm for scaling input images linearly.

Public Member Functions

- [LinearScaler](#) (double [Black](#), double [White](#))
Creates a new [LinearScaler](#) from a pair of pixel values that should be considered black and white respectively.
- byte [GetValue](#) (double Input)
Scales the input data to an appropriate image value.

Private Attributes

- double [Black](#)
- double [White](#)
- double [Slope](#)

2.116.1 Detailed Description

Algorithm for scaling input images linearly.

2.116.2 Constructor & Destructor Documentation

LinearScaler()

```
Umbrella2.Visualizer.WinForms.LinearScaler.LinearScaler (  
    double Black,  
    double White)
```

Creates a new [LinearScaler](#) from a pair of pixel values that should be considered black and white respectively.

Parameters

<i>Black</i>	The threshold under which a pixel is 0-black.
<i>White</i>	The threshold over which a pixel is 255-white.

2.116.3 Member Function Documentation**GetValue()**

```
byte Umbrella2.Visualizer.WinForms.LinearScaler.GetValue (  
    double Input)
```

Scales the input data to an appropriate image value.

Parameters

<i>Input</i>	Input value.
--------------	--------------

Returns

An 8-bit pixel intensity.

Implements [Umbrella2.Visualizer.WinForms.IFitsViewScaler](#).

2.116.4 Member Data Documentation**Black**

```
double Umbrella2.Visualizer.WinForms.LinearScaler.Black [private]
```

Slope

```
double Umbrella2.Visualizer.WinForms.LinearScaler.Slope [private]
```

White

```
double Umbrella2.Visualizer.WinForms.LinearScaler.White [private]
```

2.117 Umbrella2.Algorithms.Images.LineAnalyzer.LineDetection Class Reference

A processed line segment detection.

Public Member Functions

- override string [ToString](#) ()

Package Attributes

- List< [PixelPoint](#) > [Points](#)
Coordinates of the line segment's points.
- List< double > [PointValues](#)
Values of the line segment's points.
- double [EigenValue1](#)
First eigenvalue of the (bounding ellipse) covariance matrix.
- double [EigenValue2](#)
Second eigenvalue of the (bounding ellipse) covariance matrix.
- double [EigenAngle1](#)
First eigenvector of the (bounding ellipse) covariance matrix. Should be perpendicular to the second.
- double [EigenAngle2](#)
Second eigenvector of the (bounding ellipse) covariance matrix. Should be perpendicular to the first.
- [PixelPoint](#) [PointsCenter](#)
Center of the ellipse by taking in account only pixel positions.
- [PixelPoint](#) [Barycenter](#)
Center of the ellipse by taking in account pixel values.
- double [Flux](#)
Amount of luminous flux emitted from the line segment.

2.117.1 Detailed Description

A processed line segment detection.

2.117.2 Member Function Documentation

ToString()

```
override string Umbrella2.Algorithms.Images.LineAnalyzer.LineDetection.ToString ()
```

2.117.3 Member Data Documentation

Barycenter

```
PixelPoint Umbrella2.Algorithms.Images.LineAnalyzer.LineDetection.Barycenter [package]
```

Center of the ellipse by taking in account pixel values.

EigenAngle1

```
double Umbrella2.Algorithms.Images.LineAnalyzer.LineDetection.EigenAngle1 [package]
```

First eigenvector of the (bounding ellipse) covariance matrix. Should be perpendicular to the second.

EigenAngle2

```
double Umbrella2.Algorithms.Images.LineAnalyzer.LineDetection.EigenAngle2 [package]
```

Second eigenvector of the (bounding ellipse) covariance matrix. Should be perpendicular to the first.

EigenValue1

```
double Umbrella2.Algorithms.Images.LineAnalyzer.LineDetection.EigenValue1 [package]
```

First eigenvalue of the (bounding ellipse) covariance matrix.

EigenValue2

```
double Umbrella2.Algorithms.Images.LineAnalyzer.LineDetection.EigenValue2 [package]
```

Second eigenvalue of the (bounding ellipse) covariance matrix.

Flux

```
double Umbrella2.Algorithms.Images.LineAnalyzer.LineDetection.Flux [package]
```

Amount of luminous flux emitted from the line segment.

Points

```
List<PixelPoint> Umbrella2.Algorithms.Images.LineAnalyzer.LineDetection.Points [package]
```

Coordinates of the line segment's points.

PointsCenter

```
PixelPoint Umbrella2.Algorithms.Images.LineAnalyzer.LineDetection.PointsCenter [package]
```

Center of the ellipse by taking in account only pixel positions.

PointValues

```
List<double> Umbrella2.Algorithms.Images.LineAnalyzer.LineDetection.PointValues [package]
```

Values of the line segment's points.

2.118 Umbrella2.Algorithms.Misc.LineFit Class Reference

Fits a line to a set of points. Note that this assumes errors only in the Y-axis.

Static Public Member Functions

- static double [ComputeResidualSqSum](#) ([LinearRegression.LinearRegressionParameters](#) Parameters, double[] X, double[] Y)
Computes the sum of residuals' squares.
- static double [ComputeResidualSqSum](#) (double[] X, double[] Y)
Computes the sum of residuals' squares.
- static double [ComputeResidualSqSum](#) ([LinearRegression.LinearRegressionParameters](#) Parameters, IEnumerable< [PixelPoint](#) > Points)
Computes the sum of residuals' squares.
- static double [ComputeResidualSqSum](#) (IEnumerable< [PixelPoint](#) > Points)
Computes the sum of residuals' squares.

2.118.1 Detailed Description

Fits a line to a set of points. Note that this assumes errors only in the Y-axis.

2.118.2 Member Function Documentation**ComputeResidualSqSum() [1/4]**

```
static double Umbrella2.Algorithms.Misc.LineFit.ComputeResidualSqSum (
    double[] X,
    double[] Y) [static]
```

Computes the sum of residuals' squares.

Returns

The sum of residuals' squares..

Parameters

X	Points' X coordinates.
Y	Points' Y coordinates.

ComputeResidualSqSum() [2/4]

```
static double Umbrella2.Algorithms.Misc.LineFit.ComputeResidualSqSum (
    IEnumerable< PixelPoint > Points) [static]
```

Computes the sum of residuals' squares.

Returns

The sum of residuals' squares..

Parameters

<i>Points</i>	Points to fit.
---------------	----------------

ComputeResidualSqSum() [3/4]

```
static double Umbrella2.Algorithms.Misc.LineFit.ComputeResidualSqSum (
    LinearRegression.LinearRegressionParameters Parameters,
    double[] X,
    double[] Y) [static]
```

Computes the sum of residuals' squares.

Returns

The sum of residuals' squares..

Parameters

<i>Parameters</i>	Linear regression parameters.
<i>X</i>	Points' X coordinates.
<i>Y</i>	Points' Y coordinates.

ComputeResidualSqSum() [4/4]

```
static double Umbrella2.Algorithms.Misc.LineFit.ComputeResidualSqSum (
    LinearRegression.LinearRegressionParameters Parameters,
    IEnumerable< PixelPoint > Points) [static]
```

Computes the sum of residuals' squares.

Returns

The sum of residuals' squares..

Parameters

<i>Parameters</i>	Linear regression parameters.
<i>Points</i>	Points to fit.

2.119 Umbrella2.Algorithms.Geometry.LineIntersection Class Reference

Class for computing intersections between lines.

Static Public Member Functions

- static `Vector GetLineIntersection` (`Vector` X1, `Vector` X2, `Vector` D1, `Vector` D2)
Intersects to lines given by directions D and a point on them X and returns the distance between Xs and the intersection in units of Ds.
- static `bool IntersectLeft` (`Vector` Origin, `Vector` Direction, `int` Width, `int` Height, `out Vector` Point, `out double` Distance)
Computes the left-side intersection between a semiline and a rectangle with one corner at (0, 0).
- static `bool IntersectRight` (`Vector` Origin, `Vector` Direction, `int` Width, `int` Height, `out Vector` Point, `out double` Distance)
Computes the right-side intersection between a semiline and a rectangle with one corner at (0, 0).

2.119.1 Detailed Description

Class for computing intersections between lines.

2.119.2 Member Function Documentation

GetLineIntersection()

```
static Vector Umbrella2.Algorithms.Geometry.LineIntersection.GetLineIntersection (
    Vector X1,
    Vector X2,
    Vector D1,
    Vector D2) [static]
```

Intersects to lines given by directions D and a point on them X and returns the distance between Xs and the intersection in units of Ds.

Parameters

<i>X1</i>	Point on the first line.
<i>X2</i>	Point on the second line.
<i>D1</i>	Direction of the first line.
<i>D2</i>	Direction of the second line.

Returns

The distances (in units of direction vectors) on the lines from the point to the intersection.

IntersectLeft()

```
static bool Umbrella2.Algorithms.Geometry.LineIntersection.IntersectLeft (
    Vector Origin,
    Vector Direction,
    int Width,
    int Height,
    out Vector Point,
    out double Distance) [static]
```

Computes the left-side intersection between a semiline and a rectangle with one corner at (0, 0).

Parameters

<i>Origin</i>	Origin point of the semiline.
<i>Direction</i>	Direction of the semiline.
<i>Width</i>	Width of the rectangle.
<i>Height</i>	Height of the rectangle.
<i>Point</i>	The resulting intersection point.
<i>Distance</i>	The distance between the line support and the intersection point.

Returns

A tuple containing the intersection point and the distance from Origin to it.

IntersectRight()

```
static bool Umbrella2.Algorithms.Geometry.LineIntersection.IntersectRight (
    Vector Origin,
    Vector Direction,
    int Width,
    int Height,
    out Vector Point,
    out double Distance) [static]
```

Computes the right-side intersection between a semiline and a rectangle with one corner at (0, 0).

Parameters

<i>Origin</i>	Origin point of the semiline.
<i>Direction</i>	Direction of the semiline.
<i>Width</i>	Width of the rectangle.
<i>Height</i>	Height of the rectangle.
<i>Point</i>	The resulting intersection point.
<i>Distance</i>	The distance between the line support and the intersection point.

Returns

A tuple containing the intersection point and the distance from Origin to it.

2.120 Umbrella2.Algorithms.Pairing.LinePoolSimple Class Reference

A [MDPoolCore](#) algorithm that works by considering line fitting residuals.

Public Member Functions

- override List< [Tracklet](#) > [FindTracklets](#) ()
Pairs the sources into tracklets.

Public Member Functions inherited from Umbrella2.Algorithms.Pairing.MDPoolCore

- [MDPoolCore](#) ()
Initializes a new instance.
- void [LoadDetections](#) (List< [ImageDetection](#) > Detections)
Preloads detections into the search structures.
- void [GeneratePool](#) ()
Generates the search structures.
- List< [Tracklet](#) > [FindTracklets](#) ()
Pairs the sources into tracklets.

Public Attributes

- double [MaxLinErrorArcSec](#) = 2.0
The maximum sum of residuals in arcsec.
- double [SearchExtraBig](#) = 5.0
Amount added to the search radius if no objects are found within [SearchExtraSmall](#).
- double [SearchExtraSmall](#) = 1.0
Amount added to the search radius to ensure the detections are properly found.

Private Member Functions

- bool [VerifyPair](#) ([ImageDetection](#) a, [ImageDetection](#) b)
Checks whether a pair of detections makes reasonable sense to become a candidate object.
- bool [Line3Way](#) ([ImageDetection](#) a, [ImageDetection](#) b, [ImageDetection](#) c)
Checks whether 3 points are collinear.
- void [AnalyzePair](#) ([ImageDetection](#) a, [ImageDetection](#) b)
Attempts to find a tracklet given 2 image detections (from separate images).
- List< [ImageDetection](#) > [FindSourcesAround](#) ([ImageDetection](#) a, [ImageDetection](#) b, [DateTime](#) dt, [EquatorialPoint](#) eqp, double radius)
Finds [ImageDetection](#)s around the estimated position from other detections.

Private Attributes

- List< [ImageDetection](#)[] > [CandidatePairings](#)
Object pairings. To be later processed into [Tracklets](#).

Additional Inherited Members**Protected Attributes inherited from Umbrella2.Algorithms.Pairing.MDPoolCore**

- [QuadTree](#)< [ImageDetection](#) > [DetectionPool](#)
Quad Tree that represents the source pool.
- readonly List< [ImageDetection](#) > [PoolList](#)
List of the sources in the pool.
- readonly List< [DateTime](#) > [ObsTimes](#)
List of all the times at which we have sources in the pool.

2.120.1 Detailed Description

A [MDPoolCore](#) algorithm that works by considering line fitting residuals.

2.120.2 Member Function Documentation

AnalyzePair()

```
void Umbrella2.Algorithms.Pairing.LinePoolSimple.AnalyzePair (
    ImageDetection a,
    ImageDetection b) [private]
```

Attempts to find a tracklet given 2 image detections (from separate images).

FindSourcesAround()

```
List< ImageDetection > Umbrella2.Algorithms.Pairing.LinePoolSimple.FindSourcesAround (
    ImageDetection a,
    ImageDetection b,
    DateTime dt,
    EquatorialPoint eqp,
    double radius) [private]
```

Finds [ImageDetections](#) around the estimated position from other detections.

Parameters

<i>a</i>	First reference detection.
<i>b</i>	Second reference detection.
<i>dt</i>	Time at which to find the new detection.
<i>eqp</i>	Estimated location of the new detection.
<i>radius</i>	Search radius around the estimated location.

Returns

A list of [ImageDetection](#) that match the given conditions.

FindTracklets()

```
override List< Tracklet > Umbrella2.Algorithms.Pairing.LinePoolSimple.FindTracklets ()
```

Pairs the sources into tracklets.

Returns

The list of tracklets found by the algorithm.

Line3Way()

```
bool Umbrella2.Algorithms.Pairing.LinePoolSimple.Line3Way (  
    ImageDetection a,  
    ImageDetection b,  
    ImageDetection c) [private]
```

Checks whether 3 points are collinear.

VerifyPair()

```
bool Umbrella2.Algorithms.Pairing.LinePoolSimple.VerifyPair (  
    ImageDetection a,  
    ImageDetection b) [private]
```

Checks whether a pair of detections makes reasonable sense to become a candidate object.

2.120.3 Member Data Documentation

CandidatePairings

```
List<ImageDetection[] []> Umbrella2.Algorithms.Pairing.LinePoolSimple.CandidatePairings [private]
```

Object pairings. To be later processed into [Tracklets](#).

MaxLinErrorArcSec

```
double Umbrella2.Algorithms.Pairing.LinePoolSimple.MaxLinErrorArcSec = 2.0
```

The maximum sum of residuals in arcsec.

SearchExtraBig

```
double Umbrella2.Algorithms.Pairing.LinePoolSimple.SearchExtraBig = 5.0
```

Amount added to the search radius if no objects are found within [SearchExtraSmall](#).

SearchExtraSmall

```
double Umbrella2.Algorithms.Pairing.LinePoolSimple.SearchExtraSmall = 1.0
```

Amount added to the search radius to ensure the detections are properly found.

2.121 Umbrella2.Plugins.LoadableTypes Class Reference

Holds references to [Umbrella2](#) plugin holder elements. On loading new types, informs plugin holders that new types are available.

Static Public Member Functions

- static void [RegisterLoader](#) (string Name, [IPluggableElementLoader](#) Loader)
Registers a new plugin holder. Also informs the plugin holder of the already known types.
- static void [RegisterNewTypes](#) (Type[] Types)
Informs the plugin holders of the new available types.

Static Public Attributes

- static readonly Dictionary< string, [IPluggableElementLoader](#) > [Loaders](#) = new Dictionary<string, [IPluggableElementLoader](#)>()
List of plugin holders.

Static Private Attributes

- static List< Type > [TypeCache](#) = new List<Type>()
Contains types already discovered. The list is kept for re-announcing types to new plugin holders.

2.121.1 Detailed Description

Holds references to [Umbrella2](#) plugin holder elements. On loading new types, informs plugin holders that new types are available.

2.121.2 Member Function Documentation

RegisterLoader()

```
static void Umbrella2.Plugins.LoadableTypes.RegisterLoader (
    string Name,
    IPluggableElementLoader Loader) [static]
```

Registers a new plugin holder. Also informs the plugin holder of the already known types.

Parameters

<i>Name</i>	Name of the plugin holder.
<i>Loader</i>	The plugin holder.

RegisterNewTypes()

```
static void Umbrella2.Plugins.LoadableTypes.RegisterNewTypes (
    Type[] Types) [static]
```

Informs the plugin holders of the new available types.

Parameters

<i>Types</i>	The new available types.
--------------	--------------------------

2.121.3 Member Data Documentation

Loaders

```
readonly Dictionary<string, IPluggableElementLoader> Umbrella2.Plugins.LoadableTypes.Loaders =
new Dictionary<string, IPluggableElementLoader>() [static]
```

List of plugin holders.

TypeCache

```
List<Type> Umbrella2.Plugins.LoadableTypes.TypeCache = new List<Type>() [static], [private]
```

Contains types already discovered. The list is kept for re-announcing types to new plugin holders.

2.122 Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup Class Reference

The Location Group (Table 6) includes the elements that are used only for observatories that are not at a fixed position on the surface of the Earth, or do not have a specific MPC-assigned observatory code.

Public Attributes

- string [System](#)
Coordinate system for station coordinates and covariance.
- int? [Origin](#)
Origin of the reference system. Use public SPICE codes, e.g., 399 is the geocenter, 10 is the Sun center. Note a WGS84 coordinate system implies a ctr of 399.
- double? [Pos1](#)
Position of observer. Interpretation depends on the value of sys as follows:
- double? [Pos2](#)
Position of observer. Interpretation depends on the value of sys as follows:
- double? [Pos3](#)
Position of observer. Interpretation depends on the value of sys as follows:
- double? [PosCovariance11](#)
Upper triangular part of (pos1, pos2, pos3) covariance matrix in same units of position coordinates (e.g., km2 if sys = 'ICRF_KM'). Missing fields are presumed zero.
- double? [PosCovariance12](#)
Upper triangular part of (pos1, pos2, pos3) covariance matrix in same units of position coordinates (e.g., km2 if sys = 'ICRF_KM'). Missing fields are presumed zero.
- double? [PosCovariance13](#)
Upper triangular part of (pos1, pos2, pos3) covariance matrix in same units of position coordinates (e.g., km2 if sys = 'ICRF_KM'). Missing fields are presumed zero.
- double? [PosCovariance22](#)

Upper triangular part of (pos1, pos2, pos3) covariance matrix in same units of position coordinates (e.g., km2 if sys = 'ICRF_KM'). Missing fields are presumed zero.

- double? [PosCovariance23](#)

Upper triangular part of (pos1, pos2, pos3) covariance matrix in same units of position coordinates (e.g., km2 if sys = 'ICRF_KM'). Missing fields are presumed zero.

- double? [PosCovariance33](#)

Upper triangular part of (pos1, pos2, pos3) covariance matrix in same units of position coordinates (e.g., km2 if sys = 'ICRF_KM'). Missing fields are presumed zero.

- string [ProgramCode](#)

Program code as assigned by the MPC. Used to identify different observing programs/observers at the same telescope. For surveys and other large producers, the MPC will increment prog for a given observatory code to document a significant operational change reported by the observing team.

- string [ObsTime](#)

UTC time of the observation in ISO 8601 extended format, i.e., yyyy-mm-ddThh:mm:ss.ssZ, in UTC (note the trailing Z). For observations derived from optical telescope images this is typically the mid-exposure time of the image. Observations for which obsTime falls during a leap second are technically compliant with the ADES standard, but are strongly discouraged.

- double? [RmsTime](#)

Random component of the obsTime 1 sigma uncertainty in seconds as estimated by the observer.

2.122.1 Detailed Description

The Location Group (Table 6) includes the elements that are used only for observatories that are not at a fixed position on the surface of the Earth, or do not have a specific MPC-assigned observatory code.

These are primarily the so-called "roving" observers (obs code 247) and space-based observatories. The Location Group must be present for such cases, but must not be present if stn is associated with a stationary MPC observatory code.

2.122.2 Member Data Documentation

ObsTime

```
string Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.ObsTime
```

UTC time of the observation in ISO 8601 extended format, i.e., yyyy-mm-ddThh:mm:ss.ssZ, in UTC (note the trailing Z). For observations derived from optical telescope images this is typically the mid-exposure time of the image. Observations for which obsTime falls during a leap second are technically compliant with the ADES standard, but are strongly discouraged.

The reported time precision should be appropriate for the astrometric accuracy, but no more than 6 digits are permitted after the decimal.

Origin

```
int? Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.Origin
```

Origin of the reference system. Use public SPICE codes, e.g., 399 is the geocenter, 10 is the Sun center. Note a WGS84 coordinate system implies a ctr of 399.

Pos1

`double? Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.Pos1`

Position of observer. Interpretation depends on the value of sys as follows:

- WGS84: East longitude (deg), latitude (deg), altitude(m)
- ITRF: East longitude (deg), Rxy (km), Rz(km)
- IAU: longitude (deg), latitude (deg), altitude(m) as defined by corresponding IAU cartography standard
- ICRF_AU or ICRF_KM: Equatorial rectangular coordinates(au or km) in the IAU International Celestial Reference Frame.

Pos2

`double? Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.Pos2`

Position of observer. Interpretation depends on the value of sys as follows:

- WGS84: East longitude (deg), latitude (deg), altitude(m)
- ITRF: East longitude (deg), Rxy (km), Rz(km)
- IAU: longitude (deg), latitude (deg), altitude(m) as defined by corresponding IAU cartography standard
- ICRF_AU or ICRF_KM: Equatorial rectangular coordinates(au or km) in the IAU International Celestial Reference Frame.

Pos3

`double? Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.Pos3`

Position of observer. Interpretation depends on the value of sys as follows:

- WGS84: East longitude (deg), latitude (deg), altitude(m)
- ITRF: East longitude (deg), Rxy (km), Rz(km)
- IAU: longitude (deg), latitude (deg), altitude(m) as defined by corresponding IAU cartography standard
- ICRF_AU or ICRF_KM: Equatorial rectangular coordinates(au or km) in the IAU International Celestial Reference Frame.

PosCovariance11

`double? Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.PosCovariance11`

Upper triangular part of (pos1, pos2, pos3) covariance matrix in same units of position coordinates (e.g., km² if sys = 'ICRF_KM'). Missing fields are presumed zero.

PosCovariance12

```
double? Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.PosCovariance12
```

Upper triangular part of (pos1, pos2, pos3) covariance matrix in same units of position coordinates (e.g., km2 if sys = 'ICRF_KM'). Missing fields are presumed zero.

PosCovariance13

```
double? Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.PosCovariance13
```

Upper triangular part of (pos1, pos2, pos3) covariance matrix in same units of position coordinates (e.g., km2 if sys = 'ICRF_KM'). Missing fields are presumed zero.

PosCovariance22

```
double? Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.PosCovariance22
```

Upper triangular part of (pos1, pos2, pos3) covariance matrix in same units of position coordinates (e.g., km2 if sys = 'ICRF_KM'). Missing fields are presumed zero.

PosCovariance23

```
double? Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.PosCovariance23
```

Upper triangular part of (pos1, pos2, pos3) covariance matrix in same units of position coordinates (e.g., km2 if sys = 'ICRF_KM'). Missing fields are presumed zero.

PosCovariance33

```
double? Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.PosCovariance33
```

Upper triangular part of (pos1, pos2, pos3) covariance matrix in same units of position coordinates (e.g., km2 if sys = 'ICRF_KM'). Missing fields are presumed zero.

ProgramCode

```
string Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.ProgramCode
```

Program code as assigned by the MPC. Used to identify different observing programs/observers at the same telescope. For surveys and other large producers, the MPC will increment prog for a given observatory code to document a significant operational change reported by the observing team.

RmsTime

```
double? Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.RmsTime
```

Random component of the obsTime 1 sigma uncertainty in seconds as estimated by the observer.

System

```
string Umbrella2.Pipeline.ExtraIO.Ades.LocationGroup.System
```

Coordinate system for station coordinates and covariance.

For ground-based roving observers:

- 'WGS84' (geodetic reference ellipsoid, GPS coordinates are normally obtained in this frame)
- 'ITRF' (cylindrical)
- 'IAU' (IAU planetary cartographic model for bodies other than Earth) For space-based observatories: 'ICRF←_AU' (cartesian) 'ICRF_KM' (cartesian)

2.123 Umbrella2.Algorithms.Images.LongTrailDetector.LongTrailData Struct Reference

The bag of algorithm parameters.

Public Attributes

- int [ScanWidth](#)
The width over which to scan high-scoring lines using [LineAnalyzer](#).
- double [SigmaCount](#)
RLHT score detection threshold.
- double [Sigma](#)
Input image standard deviation.
- double [SegmentSelectThreshold](#)
Upper threshold for segment detection in [LineAnalyzer](#). Given in units of standard deviations.
- double [SegmentDropThreshold](#)
Lower threshold for segment detection in [LineAnalyzer](#). Given in units of standard deviations.
- int [MaxInterblobDistance](#)
Maximum distance that can separate two segments on the same line that are considered part of the same Median← Detection.
- bool [DropCrowdedRegion](#)
Whether to skip analyzing crowded regions (as those are more likely to contain unwanted light sources and noise than actual asteroids).
- [Image](#) [RunningImage](#)
Currently processed image.
- List< [ImageDetection](#) > [Results](#)
The results of the algorithm run.

Package Attributes

- [RLHT.ImageParameters](#) [ImageParameters](#)
Bag of RLHT parameters.
- [RLHT.AlgorithmData](#) [AgData](#)
Bag of RLHT data.

2.123.1 Detailed Description

The bag of algorithm parameters.

2.123.2 Member Data Documentation

AgData

`RLHT.AlgorithmData` Umbrella2.Algorithms.Images.LongTrailDetector.LongTrailData.AgData [package]

Bag of `RLHT` data.

DropCrowdedRegion

`bool` Umbrella2.Algorithms.Images.LongTrailDetector.LongTrailData.DropCrowdedRegion

Whether to skip analyzing crowded regions (as those are more likely to contain unwanted light sources and noise than actual asteroids).

ImageParameters

`RLHT.ImageParameters` Umbrella2.Algorithms.Images.LongTrailDetector.LongTrailData.ImageParameters [package]

Bag of `RLHT` parameters.

MaxInterblobDistance

`int` Umbrella2.Algorithms.Images.LongTrailDetector.LongTrailData.MaxInterblobDistance

Maximum distance that can separate two segments on the same line that are considered part of the same Median↔ Detection.

Results

`List<ImageDetection>` Umbrella2.Algorithms.Images.LongTrailDetector.LongTrailData.Results

The results of the algorithm run.

RunningImage

`Image` Umbrella2.Algorithms.Images.LongTrailDetector.LongTrailData.RunningImage

Currently processed image.

ScanWidth

```
int Umbrella2.Algorithms.Images.LongTrailDetector.LongTrailData.ScanWidth
```

The width over which to scan high-scoring lines using [LineAnalyzer](#).

SegmentDropThreshold

```
double Umbrella2.Algorithms.Images.LongTrailDetector.LongTrailData.SegmentDropThreshold
```

Lower threshold for segment detection in [LineAnalyzer](#). Given in units of standard deviations.

SegmentSelectThreshold

```
double Umbrella2.Algorithms.Images.LongTrailDetector.LongTrailData.SegmentSelectThreshold
```

Upper threshold for segment detection in [LineAnalyzer](#). Given in units of standard deviations.

Sigma

```
double Umbrella2.Algorithms.Images.LongTrailDetector.LongTrailData.Sigma
```

Input image standard deviation.

SigmaCount

```
double Umbrella2.Algorithms.Images.LongTrailDetector.LongTrailData.SigmaCount
```

[RLHT](#) score detection threshold.

2.124 Umbrella2.Algorithms.Images.LongTrailDetector Class Reference

The new long trail detection mechanism, replacing SegmentDetector. Versatile and documented.

Classes

- struct [LongTrailData](#)
The bag of algorithm parameters.

Static Public Member Functions

- static [LongTrailData GeneralAlgorithmSetup](#) (int PSFSize, double RLHTThreshold, double SegmentSelectThreshold, double SegmentDropThreshold, int MaxInterblobDistance, bool SimpleLine)
Function for setting up algorithm parameters.
- static void [PrepareAlgorithmForImage](#) (Image Image, ImageStatistics Stats, ref [LongTrailData](#) Data)
Infers algorithm parameters from the input image.

Static Public Attributes

- static `SchedCore.PositionDependentExtractor< LongTrailData > Algorithm = LTD_RLHT`
The long trail detection algorithm.

Properties

- static `SchedCore.AlgorithmRunParameters Parameters` [get]
Parameters for the ParallelAlgorithmRunner.

Static Private Member Functions

- static void `LTD_RLHT` (double[,.] Input, `SchedCore.ImageSegmentPosition` Position, `LongTrailData` Data)
The segment detector function. It calls the `RLHT` scorer and if line segments are sensed, it calls the `LineAnalyzer` to find the source blobs.
- static double `ThresholdComputer` (double LineLength, `LongTrailData` Data, double Diagonal)
Computes the `RLHT` score detection thresholds as a function of the line length. This particular implementation compensates for short line lengths by increasing their threshold.

2.124.1 Detailed Description

The new long trail detection mechanism, replacing SegmentDetector. Versatile and documented.

2.124.2 Member Function Documentation

GeneralAlgorithmSetup()

```
static LongTrailData Umbrella2.Algorithms.Images.LongTrailDetector.GeneralAlgorithmSetup (
    int PSFSize,
    double RLHTThreshold,
    double SegmentSelectThreshold,
    double SegmentDropThreshold,
    int MaxInterblobDistance,
    bool SimpleLine) [static]
```

Function for setting up algorithm parameters.

Parameters

<code>PSFSize</code>	Size of the PSF.
<code>RLHTThreshold</code>	<code>RLHT</code> line threshold. See documentation for more details.
<code>SegmentSelectThreshold</code>	Segment upper hysteresis threshold (for <code>LineAnalyzer</code>).
<code>SegmentDropThreshold</code>	Segment lower hysteresis threshold (for <code>LineAnalyzer</code>).
<code>MaxInterblobDistance</code>	Maximal distance between blobs of the same detection.
<code>SimpleLine</code>	Whether to use the simpler lineover function (requires well-smoothed input data).

Returns

The bag of algorithm parameters.

LTD_RLHT()

```
static void Umbrella2.Algorithms.Images.LongTrailDetector.LTD_RLHT (
    double Input[,],
    SchedCore.ImageSegmentPosition Position,
    LongTrailData Data) [static], [private]
```

The segment detector function. It calls the [RLHT](#) scorer and if line segments are sensed, it calls the [LineAnalyzer](#) to find the source blobs.

Parameters

<i>Input</i>	Input data.
<i>Position</i>	Position of the input data array in the image.
<i>Data</i>	Bag of algorithm parameters and data.

PrepareAlgorithmForImage()

```
static void Umbrella2.Algorithms.Images.LongTrailDetector.PrepareAlgorithmForImage (
    Image Image,
    ImageStatistics Stats,
    ref LongTrailData Data) [static]
```

Infers algorithm parameters from the input image.

Parameters

<i>Image</i>	Input image.
<i>Stats</i>	Input image statistical information.
<i>Data</i>	Algorithm data bag.

ThresholdComputer()

```
static double Umbrella2.Algorithms.Images.LongTrailDetector.ThresholdComputer (
    double LineLength,
    LongTrailData Data,
    double Diagonal) [static], [private]
```

Computes the [RLHT](#) score detection thresholds as a function of the line length. This particular implementation compensates for short line lengths by increasing their threshold.

Parameters

<i>LineLength</i>	Length of the line for which to compute the threshold.
<i>Data</i>	Bag of parameters for the LongTrailDetector .
<i>Diagonal</i>	Length of the image diagonal.

Returns

The [RLHT](#) score above which to scan the line for detection's blobs.

2.124.3 Member Data Documentation

Algorithm

`SchedCore.PositionDependentExtractor<LongTrailData> Umbrella2.Algorithms.Images.LongTrailDetector.Algorithm = LTD_RLHT [static]`

The long trail detection algorithm.

2.124.4 Property Documentation

Parameters

`SchedCore.AlgorithmRunParameters Umbrella2.Algorithms.Images.LongTrailDetector.Parameters [static], [get]`

Parameters for the ParallelAlgorithmRunner.

2.125 Umbrella2.Algorithms.Images.MaskByMedian Class Reference

Class for filtering out static light sources by means of a mask obtained from the median image.

Classes

- class [MaskProperties](#)
Image masking properties.

Static Public Member Functions

- static void [MaskImage](#) ([Image](#) Input, [Image](#) Output, [MaskProperties](#) Properties)
Masks an image.
- static void [CreateMasker](#) ([Image](#) Input, [MaskProperties](#) Properties, [ImageStatistics](#) Stats)
Creates a mask from a given image. The image is scanned for light sources which are then converted to a mask.

Static Public Attributes

- static [PositionDependentMap](#)< [MaskProperties](#) > [Masker](#) = [MaskImage](#)
Masking map.
- static [PositionDependentExtractor](#)< [MaskProperties](#) > [MaskGenerator](#) = [GenerateMask](#)
Mask generator.

Properties

- static [AlgorithmRunParameters](#) [Parameters](#) [get]
Default parameters for the algorithms. Do switch FillZero to false when creating masks.

Static Private Member Functions

- static void [GenerateMask](#) (double[,] Input, ImageSegmentPosition [Position](#), [MaskProperties](#) Properties)
Creates a mask from an image. All light sources are detected via a hysteresis algorithm and flagged in the mask.
- static void [BitmapFill](#) (BitArray[] Mask, double[,] MaskData, [PixelPoint](#) Alignment, [PixelPoint](#) DPoint, double LowerThreshold, double RadiusMultiplier, double ExtraRadius, out [Filtering.Star?](#) Star)
Runs the hysteresis connected component detection algorithm for light sources. At the end also applies the extra circular masking.
- static void [FillMarginsExtra](#) (BitArray[] Mask, [PixelPoint](#) Center, double Radius)
Appends circular mask to the mask data.
- static void [MaskImage](#) (double[,] Input, double[,] Output, ImageSegmentPosition InputPosition, ImageSegmentPosition OutputPosition, [MaskProperties](#) Properties)
Masks the input image with a given mask. Masked pixels are set to -1 standard deviation.

2.125.1 Detailed Description

Class for filtering out static light sources by means of a mask obtained from the median image.

2.125.2 Member Function Documentation

BitmapFill()

```
static void Umbrella2.Algorithms.Images.MaskByMedian.BitmapFill (
    BitArray[] Mask,
    double MaskData[,],
    PixelPoint Alignment,
    PixelPoint DPoint,
    double LowerThreshold,
    double RadiusMultiplier,
    double ExtraRadius,
    out Filtering.Star? Star) [static], [private]
```

Runs the hysteresis connected component detection algorithm for light sources. At the end also applies the extra circular masking.

Parameters

<i>Mask</i>	Mask array.
<i>MaskData</i>	Masking image data.
<i>Alignment</i>	Position of data in the image.
<i>DPoint</i>	Starting point for the connected component algorithm.
<i>LowerThreshold</i>	Lower hysteresis threshold.
<i>RadiusMultiplier</i>	Ratio between extra masking circle radius and light source radius.
<i>ExtraRadius</i>	Extra radius for the masking circle.
<i>Star</i>	The potential output star.

CreateMasker()

```
static void Umbrella2.Algorithms.Images.MaskByMedian.CreateMasker (
    Image Input,
    MaskProperties Properties,
    ImageStatistics Stats) [static]
```

Creates a mask from a given image. The image is scanned for light sources which are then converted to a mask.

Parameters

<i>Input</i>	Input image.
<i>Properties</i>	Masking data and parameters. The masking thresholds should be set; the other parameters are automatically filled in.
<i>Stats</i>	Image statistical information.

FillMarginsExtra()

```
static void Umbrella2.Algorithms.Images.MaskByMedian.FillMarginsExtra (
    BitArray[] Mask,
    PixelPoint Center,
    double Radius) [static], [private]
```

Appends circular mask to the mask data.

Parameters

<i>Mask</i>	Mask data.
<i>Center</i>	Disk center.
<i>Radius</i>	Disk radius.

GenerateMask()

```
static void Umbrella2.Algorithms.Images.MaskByMedian.GenerateMask (
    double Input[,],
    ImageSegmentPosition Position,
    MaskProperties Properties) [static], [private]
```

Creates a mask from an image. All light sources are detected via a hysteresis algorithm and flagged in the mask.

Parameters

<i>Input</i>	Input image data.
<i>Position</i>	Data position in the image.
<i>Properties</i>	Bag of mask data.

MaskImage() [1/2]

```
static void Umbrella2.Algorithms.Images.MaskByMedian.MaskImage (
    double Input[,],
    double Output[,],
    ImageSegmentPosition InputPosition,
    ImageSegmentPosition OutputPosition,
    MaskProperties Properties) [static], [private]
```

Masks the input image with a given mask. Masked pixels are set to -1 standard deviation.

Parameters

<i>Input</i>	Input image data.
<i>Output</i>	Output image data.
<i>InputPosition</i>	Input data position.
<i>OutputPosition</i>	Output data position.
<i>Properties</i>	Mask data.

MaskImage() [2/2]

```
static void Umbrella2.Algorithms.Images.MaskByMedian.MaskImage (
    Image Input,
    Image Output,
    MaskProperties Properties) [static]
```

Masks an image.

Parameters

<i>Input</i>	Input image.
<i>Output</i>	Output image.
<i>Properties</i>	Masking data.

2.125.3 Member Data Documentation**Masker**

```
PositionDependentMap<MaskProperties> Umbrella2.Algorithms.Images.MaskByMedian.Masker = MaskImage
[static]
```

Masking map.

MaskGenerator

```
PositionDependentExtractor<MaskProperties> Umbrella2.Algorithms.Images.MaskByMedian.Mask↔
Generator = GenerateMask [static]
```

Mask generator.

2.125.4 Property Documentation**Parameters**

```
AlgorithmRunParameters Umbrella2.Algorithms.Images.MaskByMedian.Parameters [static], [get]
```

Default parameters for the algorithms. Do switch FillZero to false when creating masks.

2.126 Umbrella2.Algorithms.Images.MaskByMedian.MaskProperties Class Reference

Image masking properties.

Public Attributes

- double [UTM](#)
Upper hysteresis threshold in standard deviations.
- double [LTM](#)
Lower hysteresis threshold in standard deviations.
- double [StDev](#)
Image standard deviation. Relevant only for median generation.
- double [Mean](#)
Image base level. Taken to be mean since most of the pixels in an image are background.
- [IWCSProjection MaskTransform](#)
WCS Transform of the mask.
- BitArray[] [MaskData](#)
Mask for the image.
- double [MaskRadiusMultiplier](#)
Ratio between light source radius and extra masking circle.
- double [ExtraMaskRadius](#)
Extra radius (in pixels) to be added to the masking circle.
- [Umbrella2.Algorithms.Filtering.StarData StarList](#)
Optional list of stars; will be populated by the algorithm if present.

2.126.1 Detailed Description

Image masking properties.

2.126.2 Member Data Documentation

ExtraMaskRadius

```
double Umbrella2.Algorithms.Images.MaskByMedian.MaskProperties.ExtraMaskRadius
```

Extra radius (in pixels) to be added to the masking circle.

LTM

```
double Umbrella2.Algorithms.Images.MaskByMedian.MaskProperties.LTM
```

Lower hysteresis threshold in standard deviations.

MaskData

```
BitArray [] Umbrella2.Algorithms.Images.MaskByMedian.MaskProperties.MaskData
```

Mask for the image.

MaskRadiusMultiplier

`double Umbrella2.Algorithms.Images.MaskByMedian.MaskProperties.MaskRadiusMultiplier`

Ratio between light source radius and extra masking circle.

MaskTransform

`IWCSProjection Umbrella2.Algorithms.Images.MaskByMedian.MaskProperties.MaskTransform`

WCS Transform of the mask.

Mean

`double Umbrella2.Algorithms.Images.MaskByMedian.MaskProperties.Mean`

Image base level. Taken to be mean since most of the pixels in an image are background.

StarList

`Umbrella2.Algorithms.Filtering.StarData Umbrella2.Algorithms.Images.MaskByMedian.MaskProperties.↔
StarList`

Optional list of stars; will be populated by the algorithm if present.

StDev

`double Umbrella2.Algorithms.Images.MaskByMedian.MaskProperties.StDev`

Image standard deviation. Relevant only for median generation.

UTM

`double Umbrella2.Algorithms.Images.MaskByMedian.MaskProperties.UTM`

Upper hysteresis threshold in standard deviations.

2.127 Umbrella2.Algorithms.Pairing.MDPoolCore Class Reference

Class of common code for Pool [Algorithms](#).

Public Member Functions

- [MDPoolCore](#) ()
Initializes a new instance.
- void [LoadDetections](#) (List< [ImageDetection](#) > Detections)
Preloads detections into the search structures.
- void [GeneratePool](#) ()
Generates the search structures.
- List< [Tracklet](#) > [FindTracklets](#) ()
Pairs the sources into tracklets.

Protected Attributes

- [QuadTree](#)< [ImageDetection](#) > [DetectionPool](#)
Quad Tree that represents the source pool.
- readonly List< [ImageDetection](#) > [PoolList](#)
List of the sources in the pool.
- readonly List< [DateTime](#) > [ObsTimes](#)
List of all the times at which we have sources in the pool.

Private Attributes

- double [Topmost](#)
- double [Lowermost](#)
- double [Leftmost](#)
- double [Rightmost](#)

Static Private Attributes

- const int [PoolDepth](#) = 10
Depth of the quad tree.

2.127.1 Detailed Description

Class of common code for Pool [Algorithms](#).

2.127.2 Constructor & Destructor Documentation

MDPoolCore()

```
Umbrella2.Algorithms.Pairing.MDPoolCore.MDPoolCore ()
```

Initializes a new instance.

2.127.3 Member Function Documentation

FindTracklets()

```
List< Tracklet > Umbrella2.Algorithms.Pairing.MDPoolCore.FindTracklets () [abstract]
```

Pairs the sources into tracklets.

Returns

The list of tracklets found by the algorithm.

GeneratePool()

```
void Umbrella2.Algorithms.Pairing.MDPoolCore.GeneratePool ()
```

Generates the search structures.

LoadDetections()

```
void Umbrella2.Algorithms.Pairing.MDPoolCore.LoadDetections (  
    List< ImageDetection > Detections)
```

Preloads detections into the search structures.

Parameters

<i>Detections</i>	Detected sources.
-------------------	-------------------

2.127.4 Member Data Documentation

DetectionPool

```
QuadTree<ImageDetection> Umbrella2.Algorithms.Pairing.MDPoolCore.DetectionPool [protected]
```

Quad Tree that represents the source pool.

Leftmost

```
double Umbrella2.Algorithms.Pairing.MDPoolCore.Leftmost [private]
```

Lowermost

```
double Umbrella2.Algorithms.Pairing.MDPoolCore.Lowermost [private]
```

ObsTimes

```
readonly List<DateTime> Umbrella2.Algorithms.Pairing.MDPoolCore.ObsTimes [protected]
```

List of all the times at which we have sources in the pool.

PoolDepth

```
const int Umbrella2.Algorithms.Pairing.MDPoolCore.PoolDepth = 10 [static], [private]
```

Depth of the quad tree.

PoolList

```
readonly List<ImageDetection> Umbrella2.Algorithms.Pairing.MDPoolCore.PoolList [protected]
```

List of the sources in the pool.

Rightmost

```
double Umbrella2.Algorithms.Pairing.MDPoolCore.Rightmost [private]
```

Topmost

```
double Umbrella2.Algorithms.Pairing.MDPoolCore.Topmost [private]
```

2.128 Umbrella2.Pipeline.ExtraIO.Ades.Meurers Class Reference

Public Attributes

- [string\[\] Name](#)
Names of meaurers (initials then surname), one individual per array element.

2.128.1 Member Data Documentation

Name

```
string [] Umbrella2.Pipeline.ExtraIO.Ades.Meurers.Name
```

Names of meaurers (initials then surname), one individual per array element.

2.129 Umbrella2.Algorithms.Images.Median.MedianSelection Class Reference

Implements quickselect for weighted medians.

Static Public Member Functions

- static double [Quickselect](#) (double[] Input, double[] Weights)
Applies the quickselect algorithm to get the weighted median.

Static Package Functions

- static double [StdSelect](#) (double[] Input, double[] Weights)
Performs the library quicksort to find weighted median.
- static unsafe double [QuickselectInternal](#) (double *Input, double *Weights, int Start, int End, int ReqDep)
Internal recursive Quickselect.

Properties

- static double [AvgDepth](#) [get]

Static Private Member Functions

- static unsafe void [PivotAndPartition](#) (double *Input, double *Weights, int Start, int End, out int PvS, out int PvL, out int PivotLow, out int PivotHigh, out double LowW, out double HighW, out double PivotW)
Finds a pivot (currently median of 3) and partitions the data.
- static unsafe void [Swap](#) (double *Input, double *Weights, int a, int b)
Swap routine. Aggressively inlined (MethodImpl 256).

Static Private Attributes

- static long [XQDepth](#) = 0
- static long [XQNum](#) = 0

2.129.1 Detailed Description

Implements quickselect for weighted medians.

Uses median of 3 with fat partitions.

2.129.2 Member Function Documentation

PivotAndPartition()

```
static unsafe void Umbrella2.Algorithms.Images.Median.MedianSelection.PivotAndPartition (
    double * Input,
    double * Weights,
    int Start,
    int End,
    out int PvS,
    out int PvL,
    out int PivotLow,
    out int PivotHigh,
    out double LowW,
    out double HighW,
    out double PivotW) [static], [private]
```

Finds a pivot (currently median of 3) and partitions the data.

Parameters

<i>Input</i>	Input values.
<i>Weights</i>	Input weights.
<i>Start</i>	Start of the interval in Input.
<i>End</i>	End of the interval in Input.
<i>PvS</i>	First value larger than the pivot.
<i>PvL</i>	First value smaller than the pivot.
<i>PivotLow</i>	Start of the pivot interval.
<i>PivotHigh</i>	End of the pivot interval.
<i>LowW</i>	Sum of weights for data lower than the pivot.
<i>HighW</i>	Sum of weights for data higher than the pivot.
<i>PivotW</i>	Sum of weights for pivot-valued data.

Quickselect()

```
static double Umbrella2.Algorithms.Images.Median.MedianSelection.Quickselect (
    double[] Input,
    double[] Weights) [static]
```

Applies the quickselect algorithm to get the weighted median.

Parameters

<i>Input</i>	Input values.
<i>Weights</i>	Weights that correspond to input values.

Returns

The median.

QuickselectInternal()

```
static unsafe double Umbrella2.Algorithms.Images.Median.MedianSelection.QuickselectInternal (
    double * Input,
    double * Weights,
    int Start,
    int End,
    int ReqDep) [static], [package]
```

Internal recursive Quickselect.

Parameters

<i>Input</i>	Input values.
<i>Weights</i>	Input weights.
<i>Start</i>	Start of the interval in Input to search.
<i>End</i>	End of the interval in Input to search.
<i>ReqDep</i>	Call depth. Used for performance statistics.

Returns

The median value.

This code is marked unsafe to skip bounds checking.

StdSelect()

```
static double Umbrella2.Algorithms.Images.Median.MedianSelection.StdSelect (
    double[] Input,
    double[] Weights) [static], [package]
```

Performs the library quicksort to find weighted median.

Parameters

<i>Input</i>	Input values.
<i>Weights</i>	Weights that correspond to the input values.

Returns

The median.

Swap()

```
static unsafe void Umbrella2.Algorithms.Images.Median.MedianSelection.Swap (
    double * Input,
    double * Weights,
    int a,
    int b) [static], [private]
```

Swap routine. Aggressively inlined (MethodImpl 256).

Parameters

<i>Input</i>	Input values.
<i>Weights</i>	Input weights.
<i>a</i>	First element to swap.
<i>b</i>	Second element to swap.

2.129.3 Member Data Documentation**XQDepth**

```
long Umbrella2.Algorithms.Images.Median.MedianSelection.XQDepth = 0 [static], [private]
```

XQNum

```
long Umbrella2.Algorithms.Images.Median.MedianSelection.XQNum = 0 [static], [private]
```

2.129.4 Property Documentation

AvgDepth

double Umbrella2.Algorithms.Images.Median.MedianSelection.AvgDepth [static], [get], [private]

2.130 Umbrella2.IO.MetadataRecord Class Reference

[Image](#) metadata record. [Image](#) properties can be extracted from it.

Public Member Functions

- [MetadataRecord](#) (string [Name](#), string [Data](#))
- bool [TryGetIntegerValue](#) (out long [Value](#))
Attempts to parse the record as an integer (without throwing exceptions).
- bool [TryGetString](#) (out string [FixedString](#))
Attempts to parse the record as a fixed string.
- bool [TryGetBoolean](#) (out bool [State](#))
Attempts to parse the record as a boolean (without throwing exceptions).
- bool [TryGet< T >](#) (out T [Value](#))
Generic, dynamically dispatched getter function. Dispatches into one of the other Try functions based on the type of the Value . Throws on the use of an incorrect type.
- bool [TryGetDouble](#) (out double [Value](#))
Attempts to parse the record as a floating point value (without throwing exceptions).
- override string [ToString](#) ()

Public Attributes

- readonly string [Name](#)
- readonly string [DataString](#)

Protected Member Functions

- long [GetIntegerValue](#) ()
Assumes the record holds an integer and parses it.

Properties

- virtual long [Long](#) [get]
Parses the value as a long.
- virtual int [Int](#) [get]
Parses the value as an int.
- virtual short [Short](#) [get]
Parses the value as a short.
- virtual sbyte [SByte](#) [get]
Parses the value as an sbyte.
- virtual byte [Byte](#) [get]
Parses the value as a byte.
- string [AsString](#) [get]
Parses the value as a string from the encoding of a [FITS](#) fixed string.
- bool [Bool](#) [get]
Parses the value as a bool.
- double [FloatingPoint](#) [get]
Parses the value as a double.

2.130.1 Detailed Description

[Image](#) metadata record. [Image](#) properties can be extracted from it.

2.130.2 Constructor & Destructor Documentation

MetadataRecord()

```
Umbrella2.IO.MetadataRecord.MetadataRecord (  
    string Name,  
    string Data)
```

2.130.3 Member Function Documentation

GetIntegerValue()

```
long Umbrella2.IO.MetadataRecord.GetIntegerValue () [abstract], [protected]
```

Assumes the record holds an integer and parses it.

Returns

The value of the record.

ToString()

```
override string Umbrella2.IO.MetadataRecord.ToString ()
```

TryGet< T >()

```
bool Umbrella2.IO.MetadataRecord.TryGet< T > (  
    out T Value)
```

Generic, dynamically dispatched getter function. Dispatches into one of the other Try functions based on the type of the *Value*. Throws on the use of an incorrect type.

Returns

true, if the parsing was successful, false otherwise.

Parameters

<i>Value</i>	The value of the record.
--------------	--------------------------

Template Parameters

<i>T</i>	The type of the returned value.
----------	---------------------------------

TryGetBoolean()

```
bool Umbrella2.IO.MetadataRecord.TryGetBoolean (  
    out bool State) [abstract]
```

Attempts to parse the record as a boolean (without throwing exceptions).

Returns

`true`, if the parsing was successful, `false` otherwise.

Parameters

<i>State</i>	The value of the record.
--------------	--------------------------

TryGetDouble()

```
bool Umbrella2.IO.MetadataRecord.TryGetDouble (  
    out double Value) [abstract]
```

Attempts to parse the record as a floating point value (without throwing exceptions).

Returns

`true`, if the parsing was successful, `false` otherwise.

Parameters

<i>Value</i>	The value of the record.
--------------	--------------------------

TryGetIntegerValue()

```
bool Umbrella2.IO.MetadataRecord.TryGetIntegerValue (  
    out long Value) [abstract]
```

Attempts to parse the record as an integer (without throwing exceptions).

Returns

`true`, if the parsing was successful, `false` otherwise.

Parameters

<i>Value</i>	The value of the record.
--------------	--------------------------

TryGetString()

```
bool Umbrella2.IO.MetadataRecord.TryGetString (  
    out string FixedString) [abstract]
```

Attempts to parse the record as a fixed string.

Returns

true, if the parsing was successful, false otherwise.

Parameters

<i>FixedString</i>	The encoded string.
--------------------	---------------------

2.130.4 Member Data Documentation

DataString

```
readonly string Umbrella2.IO.MetadataRecord.DataString
```

Name

```
readonly string Umbrella2.IO.MetadataRecord.Name
```

2.130.5 Property Documentation

AsString

```
string Umbrella2.IO.MetadataRecord.AsString [get], [abstract]
```

Parses the value as a string from the encoding of a [FITS](#) fixed string.

Bool

```
bool Umbrella2.IO.MetadataRecord.Bool [get], [abstract]
```

Parses the value as a bool.

Byte

```
virtual byte Umbrella2.IO.MetadataRecord.Byte [get]
```

Parses the value as a byte.

FloatingPoint

```
double Umbrella2.IO.MetadataRecord.FloatingPoint [get], [abstract]
```

Parses the value as a double.

Int

```
virtual int Umbrella2.IO.MetadataRecord.Int [get]
```

Parses the value as an int.

Long

```
virtual long Umbrella2.IO.MetadataRecord.Long [get]
```

Parses the value as a long.

SByte

```
virtual sbyte Umbrella2.IO.MetadataRecord.SByte [get]
```

Parses the value as an sbyte.

Short

```
virtual short Umbrella2.IO.MetadataRecord.Short [get]
```

Parses the value as a short.

2.131 Umbrella2.Algorithms.Images.ImageCombine.MinFilters Class Reference

Class for minimum-value filtering of multiple images.

Properties

- static [SchedCore.Combiner](#)< object > [MinFilter](#) [get]
Computes the minimum image of multiple input images. WCS information must be passed to the algorithm.
- static [SchedCore.Combiner](#)< object > [SemiMinFilter](#) [get]
Computes the second-minimum image of multiple input images. WCS information must be passed to the algorithm.

Static Private Member Functions

- static void [MiniFilter](#) (double[][,] Inputs, double[,] Output, [SchedCore.ImageSegmentPosition](#)[] InputPositions, [SchedCore.ImageSegmentPosition](#) OutputPosition, object empty)
Computes the minimum value of multiple images.
- static void [SeMinFilter](#) (double[][,] Inputs, double[,] Output, [SchedCore.ImageSegmentPosition](#)[] InputPositions, [SchedCore.ImageSegmentPosition](#) OutputPosition, object empty)
Computes the second minimum value of multiple images.

2.131.1 Detailed Description

Class for minimum-value filtering of multiple images.

2.131.2 Member Function Documentation

MiniFilter()

```
static void Umbrella2.Algorithms.Images.ImageCombine.MinFilters.MiniFilter (
    double Inputs[ ][,],
    double Output[, ],
    SchedCore.ImageSegmentPosition[] InputPositions,
    SchedCore.ImageSegmentPosition OutputPosition,
    object empty) [static], [private]
```

Computes the minimum value of multiple images.

Parameters

<i>Inputs</i>	Input data.
<i>Output</i>	Output data.
<i>InputPositions</i>	Input alignments.
<i>OutputPosition</i>	Output alignment.
<i>empty</i>	Dummy argument.

SeMinFilter()

```
static void Umbrella2.Algorithms.Images.ImageCombine.MinFilters.SeMinFilter (
    double Inputs[ ][,],
    double Output[, ],
    SchedCore.ImageSegmentPosition[] InputPositions,
    SchedCore.ImageSegmentPosition OutputPosition,
    object empty) [static], [private]
```

Computes the second minimum value of multiple images.

Parameters

<i>Inputs</i>	Input data.
<i>Output</i>	Output data.
<i>InputPositions</i>	Input alignments.
<i>OutputPosition</i>	Output alignment.
<i>empty</i>	Dummy argument.

2.131.3 Property Documentation

MinFilter

`SchedCore.Combiner`<object> `Umbrella2.Algorithms.Images.ImageCombine.MinFilters.MinFilter`
[static], [get]

Computes the minimum image of multiple input images. [WCS](#) information must be passed to the algorithm.

SemiMinFilter

`SchedCore.Combiner`<object> `Umbrella2.Algorithms.Images.ImageCombine.MinFilters.SemiMinFilter`
[static], [get]

Computes the second-minimum image of multiple input images. [WCS](#) information must be passed to the algorithm.

2.132 Umbrella2.IO.FITS.MissingKeywordException Class Reference

Represents a parsing error where a record with a specific keyword was expected to be present in the file headers, but it was not found.

Public Member Functions

- [MissingKeywordException](#) (string reason, string keyword)

Initializes a new instance of the T:Umbrella2.IO.FITS.MissingKeywordException class.

Properties

- string [ProblemKeyword](#) [get, private set]

Keyword which triggered this issue. May be null. Note this may not always point to the problem record, as previous records may have put the parsing code in a state where this specific keyword is not valid, although normally it would be fine.

Properties inherited from [Umbrella2.IO.FITS.IFitsParsingError](#)

Static Private Attributes

- const string [MessageFormatString](#) = "Keyword '{0}' is required for {1}, but it is missing."

Format string for Exception messages of this kind.

2.132.1 Detailed Description

Represents a parsing error where a record with a specific keyword was expected to be present in the file headers, but it was not found.

2.132.2 Constructor & Destructor Documentation

MissingKeywordException()

```
Umbrella2.IO.FITS.MissingKeywordException.MissingKeywordException (
    string reason,
    string keyword)
```

Initializes a new instance of the T:Umbrella2.IO.FITS.MissingKeywordException class.

Parameters

<i>reason</i>	Reason why the keyword was expected.
<i>keyword</i>	Keyword which is expected by the parsing code but is missing from the file.

2.132.3 Member Data Documentation

MessageFormatString

```
const string Umbrella2.IO.FITS.MissingKeywordException.MessageFormatString = "Keyword '{0}' is required for {1}, but it is missing." [static], [private]
```

Format string for Exception messages of this kind.

2.132.4 Property Documentation

ProblemKeyword

```
string Umbrella2.IO.FITS.MissingKeywordException.ProblemKeyword [get], [private set]
```

Keyword which triggered this issue. May be null. Note this may not always point to the problem record, as previous records may have put the parsing code in a state where this specific keyword is not valid, although normally it would be fine.

Implements [Umbrella2.IO.FITS.IFitsParsingError](#).

2.133 Umbrella2.IO.FITS.MMapFitsFile Class Reference

Static Public Member Functions

- static [MMapFitsFile OpenReadFile](#) (string [Path](#), [MEFImageNumberGetter](#) numberGetter=null)
Open file for reading.
- static [MMapFitsFile OpenWriteFile](#) (string [Path](#), HeaderTable Headers)
Opens the file for writing.

Package Functions

- override unsafe IntPtr [GetView](#) (int [Position](#), int Length)
Memory-maps an area in the file.
- override void [ReleaseView](#) (IntPtr View)
Releases the memory mapped file view (and associated resources).
- override void [ReleaseHandle](#) ()
Releases the file handle (memory mapping). Writing may not occur after the release. Reading reopens the handle.

Package Functions inherited from [Umbrella2.IO.FITS.FitsFile](#)

- unsafe IntPtr [GetView](#) (int [Position](#), int Length)
Memory-maps an area in the file.
- IntPtr [GetDataView](#) (int Dataset, int DSetPosition, int Length)
Memory maps image data.
- void [ReleaseView](#) (IntPtr View)
Releases the memory mapped file view (and associated resources).
- void [ReleaseHandle](#) ()
Releases the file handle. Writing may not occur after the release. Reading reopens the handle.

Private Member Functions

- [MMapFitsFile](#) (string [Path](#), bool OutputImage, [MEFImageNumberGetter](#) numberGetter, [FitsFileBuilder](#) Headers, [MemoryMappedFile](#) Handle, [MemoryMappedFileAccess](#) Access)
Opens a [FITS](#) File handle from a file on a local disk.

Private Attributes

- [MemoryMappedFile](#) [mmap](#)
- [MemoryMappedFileAccess](#) [access](#)
- readonly Dictionary< IntPtr, [MemoryMappedViewAccessor](#) > [OpenViews](#)

Additional Inherited Members

Public Member Functions inherited from [Umbrella2.IO.FITS.FitsFile](#)

- delegate int [MEFImageNumberGetter](#) (int ExtensionNumber, HeaderTable Header)
- virtual void [Close](#) ()
Disposes of all handles and large in-memory resources.
- void [ReleaseResources](#) ()
Calls [ReleaseHandle](#).

Public Attributes inherited from [Umbrella2.IO.FITS.FitsFile](#)

- readonly string [Path](#)
- readonly HeaderTable [PrimaryTable](#)
- readonly Dictionary< int, HeaderTable > [MEFHeaderTable](#)

Protected Member Functions inherited from [Umbrella2.IO.FITS.FitsFile](#)

- [FitsFile](#) (string [Path](#), bool OutputImage, [MEFImageNumberGetter](#) numberGetter, [FitsFileBuilder](#) Headers)

Protected Attributes inherited from [Umbrella2.IO.FITS.FitsFile](#)

- int [PrimaryDataPointer](#)
- readonly List< int > [ExtensionDataPointers](#)
- readonly Dictionary< int, int > [MEFDataPointers](#)
- readonly bool [OutputFile](#)

Static Package Functions inherited from Umbrella2.IO.FITS.FitsFile

- static int [DefaultGetter](#) (int ExtensionNumber, HeaderTable Header)

Properties inherited from Umbrella2.IO.FITS.FitsFile

- string [PathString](#) [get]
Path to the file. Note this may not always be a path in the filesystem.

Properties inherited from Umbrella2.IO.IBackingFile**2.133.1 Constructor & Destructor Documentation****MMapFitsFile()**

```
Umbrella2.IO.FITS.MMapFitsFile.MMapFitsFile (
    string Path,
    bool OutputImage,
    MEFImageNumberGetter numberGetter,
    FitsFileBuilder Headers,
    MemoryMappedFile Handle,
    MemoryMappedFileAccess Access) [private]
```

Opens a [FITS](#) File handle from a file on a local disk.

Parameters

<i>Path</i>	Path to where the image is stored.
<i>OutputImage</i>	Specifies whether the image is an input or an output one.
<i>numberGetter</i>	Delegate that generates the image numbers in a MEF FITS .

2.133.2 Member Function Documentation**GetView()**

```
override unsafe IntPtr Umbrella2.IO.FITS.MMapFitsFile.GetView (
    int Position,
    int Length) [package]
```

Memory-maps an area in the file.

Parameters

<i>Position</i>	Position in the file where the view should start.
<i>Length</i>	Length of the mapped file view.

Returns

Pointer to the memory mapped view.

OpenReadFile()

```
static MMapFitsFile Umbrella2.IO.FITS.MMapFitsFile.OpenReadFile (
    string Path,
    MEFImageNumberGetter numberGetter = null) [static]
```

Open file for reading.

Returns

The opened file.

Parameters

<i>Path</i>	Path to the file.
<i>numberGetter</i>	Delegate that generates the image numbers in a MEF FITS .

OpenWriteFile()

```
static MMapFitsFile Umbrella2.IO.FITS.MMapFitsFile.OpenWriteFile (
    string Path,
    HeaderTable Headers) [static]
```

Opens the file for writing.

Returns

The opened file.

Parameters

<i>Path</i>	Path to the output file.
<i>Headers</i>	FITS Headers to be written to the file.

ReleaseHandle()

```
override void Umbrella2.IO.FITS.MMapFitsFile.ReleaseHandle () [package]
```

Releases the file handle (memory mapping). Writing may not occur after the release. Reading reopens the handle.

ReleaseView()

```
override void Umbrella2.IO.FITS.MMapFitsFile.ReleaseView (
    IntPtr View) [package]
```

Releases the memory mapped file view (and associated resources).

Parameters

<i>View</i>	Pointer to the memory mapped file view.
-------------	---

2.133.3 Member Data Documentation

access

MemoryMappedFileAccess Umbrella2.IO.FITS.MMapFitsFile.access [private]

mmap

MemoryMappedFile Umbrella2.IO.FITS.MMapFitsFile.mmap [private]

OpenViews

readonly Dictionary<IntPtr, MemoryMappedViewAccessor> Umbrella2.IO.FITS.MMapFitsFile.OpenViews [private]

2.134 Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat Class Reference

Provides support for working with MPC Optical Reports.

Classes

- class [InvalidFieldException](#)
Represents an invalid [ObsInstance](#) field.
- struct [ObsInstance](#)
Instance of an observed object. Provides the object equivalent of a [MPC optical report format record](#).

Public Types

- enum [PublishingNote](#) : byte {
[none](#) = (byte) MPCSpace , [a](#) = (byte) 'a' , [A](#) = (byte) 'A' , [EarlierApproximatePositionInferior](#) = (byte) 'A' ,
[SenseOfMotionAmbiguous](#) = (byte) 'a' , [BrightSkyblackOrDarkPlate](#) = (byte) 'B' , [BadSeeing](#) = (byte) 'b' ,
[CrowdedStarField](#) = (byte) 'c' ,
[DeclinationUncertain](#) = (byte) 'D' , [DiffuselImage](#) = (byte) 'd' , [AtOrNearEdgeOfPlate](#) = (byte) 'E' , [FaintImage](#)
= (byte) 'F' ,
[InvolvedWithEmulsionOrPlateFlaw](#) = (byte) 'f' , [PoorGuiding](#) = (byte) 'G' , [NoGuiding](#) = (byte) 'g' ,
[HandMeasurementOfCCDImage](#) = (byte) 'H' ,
[ObservedThroughCloudhaze](#) = (byte) 'h' , [InvolvedWithStar](#) = (byte) 'I' , [InkdotMeasured](#) = (byte) 'i' ,
[J2000RereductionOfPreviouslyReportedPosition](#) = (byte) 'J' ,
[StackedImage](#) = (byte) 'K' , [StaremodeObservationByScanningSystem](#) = (byte) 'k' , [MeasurementDifficult](#) =
(byte) 'M' , [ImageTrackedOnObjectMotion](#) = (byte) 'm' ,
[NearEdgeOfPlateMeasurementUncertain](#) = (byte) 'N' , [ImageOutOfFocus](#) = (byte) 'O' , [PlateMeasuredInOneDirectionOnly](#)
= (byte) 'o' , [PositionUncertain](#) = (byte) 'P' ,
[PoorImage](#) = (byte) 'p' , [RightAscensionUncertain](#) = (byte) 'R' , [PoorDistributionOfReferenceStars](#) = (byte) 'r'
, [PoorSky](#) = (byte) 'S' ,
[StreakedImage](#) = (byte) 's' , [TimeUncertain](#) = (byte) 'T' , [TrailedImage](#) = (byte) 't' , [UncertainImage](#) = (byte) 'U'
,
[UnconfirmedImage](#) = (byte) 'u' , [VeryFaintImage](#) = (byte) 'V' , [WeakImage](#) = (byte) 'W' , [WeakSolution](#) = (byte)
'w' }

The Publishing Note entry of a record. See the [MPC publishing note entry](#)

- enum **MagnitudeBand** : byte {
none = (byte) MPCSpace , **B** = (byte) 'B' , **R** = (byte) 'R' , **V** = (byte) 'V' ,
I = (byte) 'I' , **J** = (byte) 'J' , **W** = (byte) 'W' , **U** = (byte) 'U' ,
g = (byte) 'g' , **r** = (byte) 'r' , **i** = (byte) 'i' , **w** = (byte) 'w' ,
y = (byte) 'y' , **z** = (byte) 'z' }

The magnitude band in which the observations took place. See [MPC optical report format](#).

- enum **Note2** : byte {
none = (byte) MPCSpace , **Photographic** = (byte) 'P' , **Encoder** = (byte) 'e' , **CCD** = (byte) 'C' ,
MeridianOrTransitCircle = (byte) 'T' , **Micrometer** = (byte) 'M' , **CorrectedWithoutRepublicationCCDObservation**
= (byte) 'c' , **OccultationDerivedObservations** = (byte) 'E' ,
OffsetObservations = (byte) 'O' , **HipparcosGeocentricObservations** = (byte) 'H' , **NormalPlace** = (byte) 'N' ,
MiniNormalPlaceDerivedFromAveragingObservationsFromVideoFrames = (byte) 'n' }

The Note2 entry of a record. See [MPC optical report format](#).

Static Public Member Functions

- static string **GenerateLine** (**ObsInstance** ObservedObject)
Creates a MPC record line from a given object observation.
- static **ObsInstance** **ParseLine** (string Line)
Parses a MPC record line.

Static Private Attributes

- const char **MPCSpace** = (char) 32
ASCII space. Defined for convenience.

2.134.1 Detailed Description

Provides support for working with MPC Optical Reports.

2.134.2 Member Enumeration Documentation

MagnitudeBand

```
enum Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.MagnitudeBand : byte
```

The magnitude band in which the observations took place. See [MPC optical report format](#).

This list of magnitude bands is not complete.

Enumerator

none	
B	
R	
V	
I	
J	
W	

U	
g	
r	
i	
w	
y	
z	

Note2

enum `Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.Note2` : byte

The Note2 entry of a record. See [MPC optical report format](#).

Enumerator

none	
Photographic	
Encoder	
CCD	
MeridianOrTransitCircle	
Micrometer	
CorrectedWithoutRepublicationCCDObservation	
OccultationDerivedObservations	
OffsetObservations	
HipparcosGeocentricObservations	
NormalPlace	
MiniNormalPlaceDerivedFromAveragingObservationsFromVideoFrames	

PublishingNote

enum `Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.PublishingNote` : byte

The Publishing Note entry of a record. See the [MPC publishing note entry](#)

Enumerator

none	
a	
A	
EarlierApproximatePositionInferior	
SenseOfMotionAmbiguous	
BrightSkyblackOrDarkPlate	
BadSeeing	
CrowdedStarField	
DeclinationUncertain	
DiffuseImage	
AtOrNearEdgeOfPlate	

Enumerator

FaintImage	
InvolvedWithEmulsionOrPlateFlaw	
PoorGuiding	
NoGuiding	
HandMeasurementOfCCDImage	
ObservedThroughCloudhaze	
InvolvedWithStar	
InkdotMeasured	
J2000RereductionOfPreviouslyReportedPosition	
StackedImage	
StaremodeObservationByScanningSystem	
MeasurementDifficult	
ImageTrackedOnObjectMotion	
NearEdgeOfPlateMeasurementUncertain	
ImageOutOfFocus	
PlateMeasuredInOneDirectionOnly	
PositionUncertain	
PoorImage	
RightAscensionUncertain	
PoorDistributionOfReferenceStars	
PoorSky	
StreakedImage	
TimeUncertain	
TrailedImage	
UncertainImage	
UnconfirmedImage	
VeryFaintImage	
WeakImage	
WeakSolution	

2.134.3 Member Function Documentation

GenerateLine()

```
static string Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.GenerateLine (
    ObsInstance ObservedObject) [static]
```

Creates a MPC record line from a given object observation.

Parameters

<i>ObservedObject</i>	The object observation instance for which to create the record.
-----------------------	---

Returns

A string containing the MPC report. Exactly 80 ASCII8 characters long.

ParseLine()

```
static ObsInstance Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.ParseLine (  
    string Line) [static]
```

Parses a MPC record line.

Parameters

<i>Line</i>	A string containing the MPC report. Must be exactly 80 ASCII8 characters long.
-------------	--

Returns

An object observation instance.

2.134.4 Member Data Documentation

MPCSpace

```
const char Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.MPCSpace = (char) 32 [static],  
[private]
```

ASCII space. Defined for convenience.

2.135 Umbrella2.Algorithms.Misc.MTPool< T > Class Template Reference

Multithreaded object pool.

Public Member Functions

- [MTPool](#) ()
Creates a new object pool.
- [T Acquire](#) ()
Acquires an object instance from the pool.
- void [Release](#) ()
Releases an object instance back in the pool.

Public Attributes

- Func< T > [Constructor](#) = null

Private Attributes

- Dictionary< int, T > [Pool](#)
- Dictionary< int, Status > [PoolStatus](#)

2.135.1 Detailed Description

Multithreaded object pool.

2.135.2 Constructor & Destructor Documentation

MTPool()

```
Umbrella2.Algorithms.Misc.MTPool< T >.MTPool ()
```

Creates a new object pool.

2.135.3 Member Function Documentation

Acquire()

```
T Umbrella2.Algorithms.Misc.MTPool< T >.Acquire ()
```

Acquires an object instance from the pool.

Returns

Release()

```
void Umbrella2.Algorithms.Misc.MTPool< T >.Release ()
```

Releases an object instance back in the pool.

2.135.4 Member Data Documentation

Constructor

```
Func<T> Umbrella2.Algorithms.Misc.MTPool< T >.Constructor = null
```

Pool

```
Dictionary<int, T> Umbrella2.Algorithms.Misc.MTPool< T >.Pool [private]
```

PoolStatus

```
Dictionary<int, Status> Umbrella2.Algorithms.Misc.MTPool< T >.PoolStatus [private]
```


2.136 Umbrella2.IO.FITS.NSStreamFitsFile Class Reference

Represents a [FITS](#) file that was read from a non-seekable stream. The file is kept in-memory.

Public Member Functions

- override void [Close](#) ()
Clears in-memory data.

Public Member Functions inherited from [Umbrella2.IO.FITS.FitsFile](#)

- delegate int [MEFImageNumberGetter](#) (int ExtensionNumber, HeaderTable Header)
- void [ReleaseResources](#) ()
Calls [ReleaseHandle](#).

Static Public Member Functions

- static [NSStreamFitsFile](#) [OpenFile](#) (Stream str, int Length, string [Path](#), [MEFImageNumberGetter](#) numberGetter←
Getter=null)
Opens a file from the given stream.

Protected Member Functions

- [NSStreamFitsFile](#) (byte[] [Data](#), string [Path](#), bool OutputImage, [MEFImageNumberGetter](#) numberGetter,
[FitsFileBuilder](#) Headers)
Wrapper for underlying constructor.

Protected Member Functions inherited from [Umbrella2.IO.FITS.FitsFile](#)

- [FitsFile](#) (string [Path](#), bool OutputImage, [MEFImageNumberGetter](#) numberGetter, [FitsFileBuilder](#) Headers)

Package Functions

- override IntPtr [GetView](#) (int [Position](#), int Length)
Ensures the data is pinned in memory and returns a view.
- override void [ReleaseView](#) (IntPtr View)
Releases the view.
- override void [ReleaseHandle](#) ()
No-op, as no handles to release.

Package Functions inherited from [Umbrella2.IO.FITS.FitsFile](#)

- unsafe IntPtr [GetView](#) (int [Position](#), int Length)
Memory-maps an area in the file.
- IntPtr [GetDataView](#) (int Dataset, int DSetPosition, int Length)
Memory maps image data.
- void [ReleaseView](#) (IntPtr View)
Releases the memory mapped file view (and associated resources).
- void [ReleaseHandle](#) ()
Releases the file handle. Writing may not occur after the release. Reading reopens the handle.

Private Attributes

- byte[] [Data](#)
File data.
- int [CC](#)
Number of open views.
- GCHandle [Handle](#)
Handle for the in-memory pinned data.

Additional Inherited Members**Public Attributes inherited from [Umbrella2.IO.FITS.FitsFile](#)**

- readonly string [Path](#)
- readonly HeaderTable [PrimaryTable](#)
- readonly Dictionary< int, HeaderTable > [MEFHeaderTable](#)

Protected Attributes inherited from [Umbrella2.IO.FITS.FitsFile](#)

- int [PrimaryDataPointer](#)
- readonly List< int > [ExtensionDataPointers](#)
- readonly Dictionary< int, int > [MEFDataPointers](#)
- readonly bool [OutputFile](#)

Static Package Functions inherited from [Umbrella2.IO.FITS.FitsFile](#)

- static int [DefaultGetter](#) (int ExtensionNumber, HeaderTable Header)

Properties inherited from [Umbrella2.IO.FITS.FitsFile](#)

- string [PathString](#) [get]
Path to the file. Note this may not always be a path in the filesystem.

Properties inherited from [Umbrella2.IO.IBackingFile](#)**2.136.1 Detailed Description**

Represents a [FITS](#) file that was read from a non-seekable stream. The file is kept in-memory.

2.136.2 Constructor & Destructor Documentation**NSStreamFitsFile()**

```
Umbrella2.IO.FITS.NSStreamFitsFile.NSStreamFitsFile (
    byte[] Data,
    string Path,
    bool OutputImage,
    MEFImageNumberGetter numberGetter,
    FitsFileBuilder Headers) [protected]
```

Wrapper for underlying constructor.

2.136.3 Member Function Documentation

Close()

```
override void Umbrella2.IO.FITS.NSStreamFitsFile.Close () [virtual]
```

Clears in-memory data.

Reimplemented from [Umbrella2.IO.FITS.FitsFile](#).

GetView()

```
override IntPtr Umbrella2.IO.FITS.NSStreamFitsFile.GetView (  
    int Position,  
    int Length) [package]
```

Ensures the data is pinned in memory and returns a view.

OpenFile()

```
static NSStreamFitsFile Umbrella2.IO.FITS.NSStreamFitsFile.OpenFile (  
    Stream str,  
    int Length,  
    string Path,  
    MEFImageNumberGetter numberGetter = null) [static]
```

Opens a file from the given stream.

Returns

The opened file.

Parameters

<i>str</i>	Input stream.
<i>Length</i>	Data length.
<i>Path</i>	Path to the data.
<i>numberGetter</i>	MEF naming policy.

ReleaseHandle()

```
override void Umbrella2.IO.FITS.NSStreamFitsFile.ReleaseHandle () [package]
```

No-op, as no handles to release.

ReleaseView()

```
override void Umbrella2.IO.FITS.NSStreamFitsFile.ReleaseView (  
    IntPtr View) [package]
```

Releases the view.

2.136.4 Member Data Documentation

CC

```
int Umbrella2.IO.FITS.NSStreamFitsFile.CC [private]
```

Number of open views.

Data

```
byte [] Umbrella2.IO.FITS.NSStreamFitsFile.Data [private]
```

File data.

Handle

```
GCHandle Umbrella2.IO.FITS.NSStreamFitsFile.Handle [private]
```

Handle for the in-memory pinned data.

2.137 Umbrella2.PropertyModel.CommonProperties.ObjectIdentity Class Reference

Contains information on the identity of the object observed (i.e. which celestial body it is).

Public Member Functions

- void [AddName](#) (string [Name](#), int? [ObjID](#), double [Distance](#))
Adds a possible name for an object.
- void [ComputeNamescore](#) ([Tracklet](#) t)
Computes [NameScore](#) and attempts to set [Name](#).
- void [ComputeNamescoreWithDefault](#) ([Tracklet](#) t, string [Default](#)=null, string [FieldName](#)=null, int? [CCD](#)=null, int? [ObjNum](#)=null)
Computes [NameScore](#) and attempts to set [Name](#). Uses the provided [Default](#) name as the lowest priority option. Can compute [Default](#) from [FieldName](#) , [ObjNum](#) and optionally [CCD](#) . If no [Default](#) is given and it cannot be computed, skips using a default name.

Static Public Member Functions

- static string [PackMPN](#) (int [ObjMpn](#))
Packs the minor planet number to MPC packed form.
- static string [PackPD](#) (string [ObjName](#))
Converts a provisional designation to its packed form.

Public Attributes

- string [Name](#)
Name of the observed object.
- int? [MPN](#)
Minor planet number.
- string [PackedPD](#)
Packed provisional designation.
- string [PackedMPN](#)
Packed minor planet number.
- Dictionary< string, int > [NameScore](#) = new Dictionary<string, int>()
Scores for each possible object name.

Static Public Attributes

- static readonly System.Text.RegularExpressions.Regex [ProvisionalDesignationMatcher](#)
Matches provisional designations.

Static Private Member Functions

- static string [GetObjNumber](#) (int ObjNum)
- static char [GetB62Char](#) (int V)

Private Attributes

- Dictionary< string, double > [Distances](#) = new Dictionary<string, double>()
Distances from object to name.
- Dictionary< string, int > [Counts](#) = new Dictionary<string, int>()
Number of times the name appeared.
- Dictionary< string, int? > [ObjIDs](#) = new Dictionary<string, int?>()
Minor planet numbers.

Static Private Attributes

- const double [Arc1Sec](#) = Math.PI / 3600 / 180
- const int [NScore](#) = 10
Minimum score to name an object.
- const string [FRegex](#) = "[0-9]{4} [A-Z]{2}[0-9]{0,3}"
Provisional designation rule.

2.137.1 Detailed Description

Contains information on the identity of the object observed (i.e. which celestial body it is).

2.137.2 Member Function Documentation

AddName()

```
void Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.AddName (
    string Name,
    int? ObjID,
    double Distance)
```

Adds a possible name for an object.

ComputeNamescore()

```
void Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.ComputeNamescore (
    Tracklet t)
```

Computes [NameScore](#) and attempts to set [Name](#).

ComputeNamescoreWithDefault()

```
void Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.ComputeNamescoreWithDefault (
    Tracklet t,
    string Default = null,
    string FieldName = null,
    int? CCD = null,
    int? ObjNum = null)
```

Computes [NameScore](#) and attempts to set [Name](#). Uses the provided *Default* name as the lowest priority option. Can compute *Default* from *FieldName*, *ObjNum* and optionally *CCD*. If no *Default* is given and it cannot be computed, skips using a default name.

If no *CCD* value is given, generates object names as *FieldName* + *ObjectNumber* base 10 (3 digits). If *CCD* is non-null, then generates name as *FieldName* + *CCD* base-62 (1 digit) + *ObjectNumber* (packed).

Parameters

<i>t</i>	Tracklet to be named.
<i>Default</i>	Default name. If null, it is generated from the next parameters. Otherwise, the other parameters can be null.
<i>FieldName</i>	Field name. Must be 4 characters long.
<i>CCD</i>	CCD Number. If present, uses the MPC 0-9, A-Z, a-z packing for both the CCD and the object number.
<i>ObjNum</i>	Object number.

GetB62Char()

```
static char Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.GetB62Char (
    int V) [static], [private]
```

GetObjNumber()

```
static string Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.GetObjNumber (
    int ObjNum) [static], [private]
```

PackMPN()

```
static string Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.PackMPN (
    int ObjMpn) [static]
```

Packs the minor planet number to MPC packed form.

PackPD()

```
static string Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.PackPD (
    string ObjName) [static]
```

Converts a provisional designation to its packed form.

2.137.3 Member Data Documentation

Arc1Sec

```
const double Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.Arc1Sec = Math.PI / 3600
/ 180 [static], [private]
```

Counts

```
Dictionary<string, int> Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.Counts = new
Dictionary<string, int>() [private]
```

Number of times the name appeared.

Distances

```
Dictionary<string, double> Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.Distances =
new Dictionary<string, double>() [private]
```

Distances from object to name.

FRegex

```
const string Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.FRegex = "[0-9]{4} [A-Z]{2}[0-9]{0,3}"
[static], [private]
```

Provisional designation rule.

MPN

```
int? Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.MPN
```

Minor planet number.

Name

```
string Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.Name
```

Name of the observed object.

NameScore

```
Dictionary<string, int> Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.NameScore =  
new Dictionary<string, int>()
```

Scores for each possible object name.

NScore

```
const int Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.NScore = 10 [static], [private]
```

Minimum score to name an object.

ObjIDs

```
Dictionary<string, int?> Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.ObjIDs = new  
Dictionary<string, int?>() [private]
```

Minor planet numbers.

PackedMPN

```
string Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.PackedMPN
```

Packed minor planet number.

PackedPD

```
string Umbrella2.PropertyModel.CommonProperties.ObjectIdentity.PackedPD
```

Packed provisional designation.

ProvisionalDesignationMatcher

```
readonly System.Text.RegularExpressions.Regex Umbrella2.PropertyModel.CommonProperties.↵  
ObjectIdentity.ProvisionalDesignationMatcher [static]
```

Initial value:

```
= new System.Text.RegularExpressions.Regex(FRegex,  
    System.Text.RegularExpressions.RegexOptions.Compiled)
```

Matches provisional designations.

2.138 Umbrella2.PropertyModel.CommonProperties.ObjectPhotometry Class Reference

Photometry measurements on the object.

Public Attributes

- double [Flux](#)
The object's flux as measured on the image.
- double [Magnitude](#)
The object's magnitude. Zero or double.NaN values represent no magnitude.

2.138.1 Detailed Description

Photometry measurements on the object.

2.138.2 Member Data Documentation

Flux

```
double Umbrella2.PropertyModel.CommonProperties.ObjectPhotometry.Flux
```

The object's flux as measured on the image.

Magnitude

```
double Umbrella2.PropertyModel.CommonProperties.ObjectPhotometry.Magnitude
```

The object's magnitude. Zero or double.NaN values represent no magnitude.

2.139 Umbrella2.PropertyModel.CommonProperties.ObjectPoints Class Reference

The collection of points covered by an object.

Public Attributes

- [EquatorialPoint\[\]](#) [EquatorialPoints](#)
List of pixels covered by an object in equatorial coordinates.
- [PixelPoint\[\]](#) [PixelPoints](#)
List of pixels covered by an object in image coordinates.
- [double\[\]](#) [PixelValues](#)
List of values of the comprising pixels.

2.139.1 Detailed Description

The collection of points covered by an object.

2.139.2 Member Data Documentation

EquatorialPoints

`EquatorialPoint [] Umbrella2.PropertyModel.CommonProperties.ObjectPoints.EquatorialPoints`

List of pixels covered by an object in equatorial coordinates.

PixelPoints

`PixelPoint [] Umbrella2.PropertyModel.CommonProperties.ObjectPoints.PixelPoints`

List of pixels covered by an object in image coordinates.

PixelValues

`double [] Umbrella2.PropertyModel.CommonProperties.ObjectPoints.PixelValues`

List of values of the comprising pixels.

2.140 Umbrella2.PropertyModel.CommonProperties.ObjectSize Class Reference

Holds information on the size of the object.

Public Attributes

- [SourceEllipse](#) [PixelEllipse](#)
The elliptical fit over the objects pixels.
- [SourceEllipse](#) [BarycentricEllipse](#)
The intensity-weighted elliptical fit over the object's pixels.

2.140.1 Detailed Description

Holds information on the size of the object.

2.140.2 Member Data Documentation

BarycentricEllipse

`SourceEllipse` Umbrella2.PropertyModel.CommonProperties.ObjectSize.BarycentricEllipse

The intensity-weighted elliptical fit over the object's pixels.

PixelEllipse

`SourceEllipse` Umbrella2.PropertyModel.CommonProperties.ObjectSize.PixelEllipse

The elliptical fit over the objects pixels.

2.141 Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry Struct Reference

Public Attributes

- double? [Flux](#)
- double? [Mag](#)
- double [X](#)
- double [Y](#)
- double [RA](#)
- double [Dec](#)
- double? [FWHM](#)
- double? [Ellipticity](#)
- double? [A](#)
- double? [B](#)
- double? [EllipseTheta](#)
- int? [Flags](#)

2.141.1 Member Data Documentation

A

double? Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry.A

B

double? Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry.B

Dec

```
double Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry.Dec
```

EllipseTheta

```
double? Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry.EllipseTheta
```

Ellipticity

```
double? Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry.Ellipticity
```

Flags

```
int? Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry.Flags
```

Flux

```
double? Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry.Flux
```

FWHM

```
double? Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry.FWHM
```

Mag

```
double? Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry.Mag
```

RA

```
double Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry.RA
```

X

```
double Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry.X
```

Y

```
double Umbrella2.Pipeline.ExtraIO.SourceExtractor.ObsEntry.Y
```

2.142 Umbrella2.Pipeline.ExtraIO.Ades.ObservationContext Class Reference

Public Attributes

- [Observatory](#) [Observatory](#)
- [Submitter](#) [Submitter](#)
- [Observers](#) [Observers](#)
- [Measurers](#) [Measurers](#)
- [Telescope](#) [Telescope](#)
- [Software](#) [Software](#)
- [Coinvestigators](#) [Coinvestigators](#)
- [Collaborators](#) [Collaborators](#)
- string [FundingSource](#)
Description of source of funding.
- [Comment](#) [Comment](#)

2.142.1 Member Data Documentation

Coinvestigators

[Coinvestigators](#) Umbrella2.Pipeline.ExtraIO.Ades.ObservationContext.Coinvestigators

Collaborators

[Collaborators](#) Umbrella2.Pipeline.ExtraIO.Ades.ObservationContext.Collaborators

Comment

[Comment](#) Umbrella2.Pipeline.ExtraIO.Ades.ObservationContext.Comment

FundingSource

string Umbrella2.Pipeline.ExtraIO.Ades.ObservationContext.FundingSource

Description of source of funding.

Measurers

[Measurers](#) Umbrella2.Pipeline.ExtraIO.Ades.ObservationContext.Measurers

Observatory

[Observatory](#) Umbrella2.Pipeline.ExtraIO.Ades.ObservationContext.Observatory

Observers

[Observers](#) Umbrella2.Pipeline.ExtraIO.Ades.ObservationContext.Observers

Software

[Software](#) Umbrella2.Pipeline.ExtraIO.Ades.ObservationContext.Software

Submitter

[Submitter](#) Umbrella2.Pipeline.ExtraIO.Ades.ObservationContext.Submitter

Telescope

[Telescope](#) Umbrella2.Pipeline.ExtraIO.Ades.ObservationContext.Telescope

2.143 Umbrella2.Pipeline.ExtraIO.Ades.ObservationGroup Class Reference

The Observation Group encapsulates the astrometry and its associated uncertainty.

Public Attributes

- double [RA](#)
J2000.0 Astrometric equatorial right ascension in decimal degrees,.
- double [Dec](#)
J2000.0 Astrometric equatorial declination in decimal degrees. Positive DEC values may optionally include a + sign.
- double? [RmsRA](#)
*Random component of the $RA * \cos(Dec)$ 1 sigma uncertainty in arcseconds, as estimated by the observer, as part of the image processing and astrometric reduction.*
- double? [RmsDec](#)
Random component of the declination 1 sigma uncertainty in arcseconds, as estimated by the observer, as part of the image processing and astrometric reduction.
- double? [CorrelationFactor](#)
*Correlation between RA and Dec that may result from the astrometric reduction. This is derived from the RA-Dec covariance matrix, where the off-diagonal term is $rmsCorr * rmsRA * rmsDec$.*
- string [AstrometricCatalog](#)
Star catalog used for the astrometric reduction. This field must be present, and so a specified value, e.g., 'UNK', will be used for some archival observations to indicate that the astrometric catalog is unknown.

2.143.1 Detailed Description

The Observation Group encapsulates the astrometry and its associated uncertainty.

For optical observations, the elements are straightforward, with [RA](#) and [Dec](#) both being required and the associated uncertainties, [RmsRA](#) and [RmsDec](#), being optional.

2.143.2 Member Data Documentation

AstrometricCatalog

```
string Umbrella2.Pipeline.ExtraIO.Ades.ObservationGroup.AstrometricCatalog
```

Star catalog used for the astrometric reduction. This field must be present, and so a specified value, e.g., 'UNK', will be used for some archival observations to indicate that the astrometric catalog is unknown.

CorrelationFactor

```
double? Umbrella2.Pipeline.ExtraIO.Ades.ObservationGroup.CorrelationFactor
```

Correlation between RA and Dec that may result from the astrometric reduction. This is derived from the RA-Dec covariance matrix, where the off-diagonal term is $\text{rmsCorr} * \text{rmsRA} * \text{rmsDec}$.

Dec

```
double Umbrella2.Pipeline.ExtraIO.Ades.ObservationGroup.Dec
```

J2000.0 Astrometric equatorial declination in decimal degrees. Positive DEC values may optionally include a + sign.

RA

```
double Umbrella2.Pipeline.ExtraIO.Ades.ObservationGroup.RA
```

J2000.0 Astrometric equatorial right ascension in decimal degrees,.

RmsDec

```
double? Umbrella2.Pipeline.ExtraIO.Ades.ObservationGroup.RmsDec
```

Random component of the declination 1 sigma uncertainty in arcseconds, as estimated by the observer, as part of the image processing and astrometric reduction.

Presumed systematic errors, e.g., those arising from star catalog biases, should not be included in the uncertainties reported in this field. rmsRA^2 and rmsDec^2 are the diagonal elements of the RA-Dec covariance matrix, which convolves errors from target PSF fitting, telescope tracking, reference star fit, etc.

RmsRA

```
double? Umbrella2.Pipeline.ExtraIO.Ades.ObservationGroup.RmsRA
```

Random component of the $\text{RA} * \cos(\text{Dec})$ 1 sigma uncertainty in arcseconds, as estimated by the observer, as part of the image processing and astrometric reduction.

Presumed systematic errors, e.g., those arising from star catalog biases, should not be included in the uncertainties reported in this field. rmsRA^2 and rmsDec^2 are the diagonal elements of the RA-Dec covariance matrix, which convolves errors from target PSF fitting, telescope tracking, reference star fit, etc.

2.144 Umbrella2.Pipeline.ExtraIO.Ades.ObservationGroupAttribute Class Reference

Represent a group in an observation entry. These groups are merged together in the observation entry.

Public Member Functions

- [ObservationGroupAttribute](#) (string groupName)

Public Member Functions inherited from [Umbrella2.Pipeline.ExtraIO.Ades.GroupAttribute](#)

- [GroupAttribute](#) (string groupName, bool nest)

Additional Inherited Members

Public Attributes inherited from [Umbrella2.Pipeline.ExtraIO.Ades.GroupAttribute](#)

- string [GroupName](#)
Name of the group, as shown in ADES specification.
- bool [Nest](#)
If `true` nest, otherwise flatten the XML hierarchy.

2.144.1 Detailed Description

Represent a group in an observation entry. These groups are merged together in the observation entry.

2.144.2 Constructor & Destructor Documentation

ObservationGroupAttribute()

```
Umbrella2.Pipeline.ExtraIO.Ades.ObservationGroupAttribute.ObservationGroupAttribute (
    string groupName)
```

2.145 Umbrella2.IO.FITS.KnownKeywords.ObservationTime Class Reference

Records for specifying the observation time of the frame.

Public Member Functions

- [ObservationTime](#) (DateTime StartTime, TimeSpan Exposure)
Instantiates a new object with the provided values.
- [ObservationTime](#) (Image File)
- override List< [MetadataRecord](#) > [GetRecords](#) ()

Public Member Functions inherited from [Umbrella2.IO.ImageProperties](#)

- [ImageProperties](#) ([Image](#) [Image](#))
Creates a new instance of the image properties for the given image.
- List< [MetadataRecord](#) > [GetRecords](#) ()
Gets the list of metadata records associated with the property.

Public Attributes

- readonly DateTime [Time](#)
Observation time of the image. As given in image fields, but assumed to be since the start of the observation.
- readonly TimeSpan [Exposure](#)
Exposure of the image, as given by EXPTIME.
- readonly DateTime [MidExposure](#)
Middle of exposure, as inferred from headers.

Private Member Functions

- TimeSpan [ParseHMS](#) (string Hour, string Minutes, string Seconds)

Static Private Attributes

- static readonly System.Globalization.DateTimeFormatInfo [InvariantFormat](#) = System.Globalization.DateTimeFormatInfo.InvariantInfo
- static readonly System.Globalization.DateTimeStyles [RoundtripStyle](#) = System.Globalization.DateTimeStyles.RoundtripKind
- const string [RoundtripFormat](#) = "o"

2.145.1 Detailed Description

Records for specifying the observation time of the frame.

2.145.2 Constructor & Destructor Documentation**ObservationTime()** [1/2]

```
Umbrella2.IO.FITS.KnownKeywords.ObservationTime.ObservationTime (
    DateTime StartTime,
    TimeSpan Exposure)
```

Instantiates a new object with the provided values.

Parameters

<i>StartTime</i>	Time at the start of the exposure.
<i>Exposure</i>	Exposure length.

ObservationTime() [2/2]

```
Umbrella2.IO.FITS.KnownKeywords.ObservationTime.ObservationTime (  
    Image File)
```

2.145.3 Member Function Documentation

GetRecords()

```
override List< MetadataRecord > Umbrella2.IO.FITS.KnownKeywords.ObservationTime.GetRecords ()
```

ParseHMS()

```
TimeSpan Umbrella2.IO.FITS.KnownKeywords.ObservationTime.ParseHMS (  
    string Hour,  
    string Minutes,  
    string Seconds) [private]
```

2.145.4 Member Data Documentation

Exposure

```
readonly TimeSpan Umbrella2.IO.FITS.KnownKeywords.ObservationTime.Exposure
```

Exposure of the image, as given by EXPTIME.

InvariantFormat

```
readonly System.Globalization.DateTimeFormatInfo Umbrella2.IO.FITS.KnownKeywords.ObservationTime.InvariantFormat = System.Globalization.DateTimeFormatInfo.InvariantInfo [static], [private]
```

MidExposure

```
readonly DateTime Umbrella2.IO.FITS.KnownKeywords.ObservationTime.MidExposure
```

Middle of exposure, as inferred from headers.

RoundtripFormat

```
const string Umbrella2.IO.FITS.KnownKeywords.ObservationTime.RoundtripFormat = "o" [static], [private]
```

RoundtripStyle

```
readonly System.Globalization.DateTimeStyles Umbrella2.IO.FITS.KnownKeywords.ObservationTime.RoundtripStyle = System.Globalization.DateTimeStyles.RoundtripKind [static], [private]
```

Time

```
readonly DateTime Umbrella2.IO.FITS.KnownKeywords.ObservationTime.Time
```

Observation time of the image. As given in image fields, but assumed to be since the start of the observation.

There is no standard way of determining whether the Time field refers to the start of the observation.

2.146 Umbrella2.Pipeline.ExtraIO.Ades.Observatory Class Reference

Public Attributes

- string [MpcCode](#)
MPC assigned observatory code (of 3 or 4 char. receiver for radar).
- string [Name](#)
Observatory name.

2.146.1 Member Data Documentation

MpcCode

```
string Umbrella2.Pipeline.ExtraIO.Ades.Observatory.MpcCode
```

MPC assigned observatory code (of 3 or 4 char. receiver for radar).

Name

```
string Umbrella2.Pipeline.ExtraIO.Ades.Observatory.Name
```

[Observatory](#) name.

2.147 Umbrella2.Pipeline.ExtraIO.Ades.Observers Class Reference

Public Attributes

- string[] [Name](#)
Names of observers (initials then surname), one individual per array element.

2.147.1 Member Data Documentation

Name

```
string [] Umbrella2.Pipeline.ExtraIO.Ades.Observers.Name
```

Names of observers (initials then surname), one individual per array element.

2.148 Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.ObsInstance Struct Reference

Instance of an observed object. Provides the object equivalent of a `MPC optical report format` record.

Public Attributes

- string `PackedMPN`
- string `ObjectDesignation`
- bool `DetectionAsterisk`
- `PublishingNote` `PubNote`
- `Note2` `N2`
- `DateTime?` `ObsTime`
- `EquatorialPoint?` `Coordinates`
- `double?` `Mag`
- `MagnitudeBand` `MagBand`
- string `ObservatoryCode`

2.148.1 Detailed Description

Instance of an observed object. Provides the object equivalent of a `MPC optical report format` record.

2.148.2 Member Data Documentation

Coordinates

`EquatorialPoint?` `Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.ObsInstance.Coordinates`

DetectionAsterisk

`bool` `Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.ObsInstance.DetectionAsterisk`

Mag

`double?` `Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.ObsInstance.Mag`

MagBand

`MagnitudeBand` `Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.ObsInstance.MagBand`

N2

`Note2` `Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.ObsInstance.N2`

ObjectDesignation

`string Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.ObsInstance.ObjectDesignation`

ObservatoryCode

`string Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.ObsInstance.ObservatoryCode`

ObsTime

`DateTime? Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.ObsInstance.ObsTime`

PackedMPN

`string Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.ObsInstance.PackedMPN`

PubNote

`PublishingNote Umbrella2.Pipeline.ExtraIO.MPCOpticalReportFormat.ObsInstance.PubNote`

2.149 Umbrella2.Pipeline.ExtraIO.Ades.OpticalObservation Class Reference

Entry for an optical observation.

Public Attributes

- [IdentificationGroup Identification](#)
Information about which asteroid was observed (including from where).
- [LocationGroup Location](#)
Detailed information on observing location (particularly for roving observers).
- [ObservationGroup Observation](#)
Astrometry of the observation.
- [PhotometryGroup Photometry](#)
Photometry of the observation.
- [PrecisionGroup Precision](#)
Information on the precision of measurements, particularly for older results.
- [ResidualsGroup Residuals](#)
Provides information on residuals from fitting with a known (orbital and photometric) object/model.

2.149.1 Detailed Description

Entry for an optical observation.

2.149.2 Member Data Documentation

Identification

`IdentificationGroup` `Umbrella2.Pipeline.ExtraIO.Ades.OpticalObservation.Identification`

Information about which asteroid was observed (including from where).

Location

`LocationGroup` `Umbrella2.Pipeline.ExtraIO.Ades.OpticalObservation.Location`

Detailed information on observing location (particularly for roving observers).

Observation

`ObservationGroup` `Umbrella2.Pipeline.ExtraIO.Ades.OpticalObservation.Observation`

Astrometry of the observation.

Photometry

`PhotometryGroup` `Umbrella2.Pipeline.ExtraIO.Ades.OpticalObservation.Photometry`

Photometry of the observation.

Precision

`PrecisionGroup` `Umbrella2.Pipeline.ExtraIO.Ades.OpticalObservation.Precision`

Information on the precision of measurements, particularly for older results.

Residuals

`ResidualsGroup` `Umbrella2.Pipeline.ExtraIO.Ades.OpticalObservation.Residuals`

Provides information on residuals from fitting with a known (orbital and photometric) object/model.

2.150 `Umbrella2.PropertyModel.CommonProperties.PairingProperties` Class Reference

Holds information relevant to object pairing.

Public Attributes

- bool [StarPolluted](#)
Marks an object that is close enough to a star that its flux could have been influenced.
- bool [IsPaired](#)
Marks an object that has already been paired into a tracklet.
- bool [IsDotDetection](#)
Marks a trailless detection.
- double [PearsonR](#)
The Pearson R correlation coefficient of the object's pixels.
- [DetectionAlgorithm](#) [Algorithm](#)
Which algorithm(s) produced the detection.
- bool [MultiNoPoints](#)
If `true`, detection has multiple detections with no [ObjectPoints](#).

2.150.1 Detailed Description

Holds information relevant to object pairing.

2.150.2 Member Data Documentation

Algorithm

[DetectionAlgorithm](#) `Umbrella2.PropertyModel.CommonProperties.PairingProperties.Algorithm`

Which algorithm(s) produced the detection.

IsDotDetection

`bool Umbrella2.PropertyModel.CommonProperties.PairingProperties.IsDotDetection`

Marks a trailless detection.

IsPaired

`bool Umbrella2.PropertyModel.CommonProperties.PairingProperties.IsPaired`

Marks an object that has already been paired into a tracklet.

MultiNoPoints

`bool Umbrella2.PropertyModel.CommonProperties.PairingProperties.MultiNoPoints`

If `true`, detection has multiple detections with no [ObjectPoints](#).

PearsonR

```
double Umbrella2.PropertyModel.CommonProperties.PairingProperties.PearsonR
```

The Pearson R correlation coefficient of the object's pixels.

StarPolluted

```
bool Umbrella2.PropertyModel.CommonProperties.PairingProperties.StarPolluted
```

Marks an object that is close enough to a star that its flux could have been influenced.

2.151 Umbrella2.Algorithms.Tools.PhotometryAperture Class Reference

Aperture photometry tool. Measures intensity of an area of the image relative to its surrounding area.

Classes

- struct [PhotometryMeasurementResult](#)
Result of a photometric measurement.

Static Public Member Functions

- static [PhotometryMeasurementResult MeasureCircularAperture](#) ([PixelPoint](#) Center, double RadiusObject, double RadiusFree, [Image](#) MeasurementImage)
Measures the luminous flux inside the specified circular apertures.

Static Private Member Functions

- static [PhotometryMeasurementResult MeasureCircularAperture](#) (double RadiusObject, double RadiusFree, double[,] Data, double CX, double CY)
Measures the luminous flux inside the specified circular apertures.

2.151.1 Detailed Description

Aperture photometry tool. Measures intensity of an area of the image relative to its surrounding area.

2.151.2 Member Function Documentation

MeasureCircularAperture() [1/2]

```
static PhotometryMeasurementResult Umbrella2.Algorithms.Tools.PhotometryAperture.MeasureCircularAperture (
    double RadiusObject,
    double RadiusFree,
    double Data[,],
    double CX,
    double CY) [static], [private]
```

Measures the luminous flux inside the specified circular apertures.

Parameters

<i>RadiusObject</i>	Radius of the central circular aperture, in pixels.
<i>RadiusFree</i>	Outer radius of the surrounding annular aperture, in pixels.
<i>Data</i>	Window containing the object to be measured. The object and free radii have to fit around the object.
<i>CX</i>	X coordinate of the center of the object to measure.
<i>CY</i>	Y coordinate of the center of the object to measure.

Returns

The detailed measurement results.

MeasureCircularAperture() [2/2]

```
static PhotometryMeasurementResult Umbrella2.Algorithms.Tools.PhotometryAperture.Measure↔
CircularAperture (
    PixelPoint Center,
    double RadiusObject,
    double RadiusFree,
    Image MeasurementImage) [static]
```

Measures the luminous flux inside the specified circular apertures.

Parameters

<i>Center</i>	Center of the apertures.
<i>RadiusObject</i>	Radius of the central circular aperture, in pixels.
<i>RadiusFree</i>	Outer radius of the surrounding annular aperture, in pixels.
<i>MeasurementImage</i>	Image on which the photometric measurement is done.

Returns

The detailed measurement results.

2.152 Umbrella2.Pipeline.ExtraIO.Ades.PhotometryGroup Class Reference

Any photometric observations are reported within the optional Photometry Group.

Public Attributes

- double [Magnitude](#)
Apparent Magnitude in specified band.
- double? [RmsMagnitude](#)
Apparent magnitude 1 sigma uncertainty in magnitudes.
- string [MpcBand](#)
Filter designation for photometry.
- string [PhotometricCatalog](#)

- Star catalog used for photometry measurements.*

 - double? [Aperture](#)

Photometric aperture radius in arcseconds.
 - double? [LogSNR](#)

Log10 of the signal-to-noise ratio of the source in the image integrated on the entire aperture used for the astrometric centroid.
 - double? [FWHM](#)

Size of seeing disc in arcseconds, measured at Full Width Half Maximum (FWHM) of target point spread function (PSF).
 - double? [ExpTime](#)

Exposure time in seconds. Total exposure time in the case of stacked image detections.
 - double? [RmsAstrometricFit](#)

RMS of fit of astrometric comparison stars in arcseconds.
 - int? [NumStars](#)

Number of reference stars in astrometric fit.
 - int? [CenterOfMass](#)

Flag to indicate that the observation is reduced to the center of mass, 0 for false, 1 for true. False implies a measurement to the peak power position, which is usually interpreted as the leading edge of the target, with the reflection point being modeled one object radius prior to the center of mass. Assumed true if not present.

2.152.1 Detailed Description

Any photometric observations are reported within the optional Photometry Group.

[Observers](#) should note that the photometric band to report is the same as that of the reference star magnitudes used to calibrate the exposure. It is not necessarily the same as the filter through which the exposure was taken. In particular, unfiltered exposures should never be reported with a band of 'none' or 'clear'.

2.152.2 Member Data Documentation

Aperture

```
double? Umbrella2.Pipeline.ExtraIO.Ades.PhotometryGroup.Aperture
```

Photometric aperture radius in arcseconds.

CenterOfMass

```
int? Umbrella2.Pipeline.ExtraIO.Ades.PhotometryGroup.CenterOfMass
```

Flag to indicate that the observation is reduced to the center of mass, 0 for false, 1 for true. False implies a measurement to the peak power position, which is usually interpreted as the leading edge of the target, with the reflection point being modeled one object radius prior to the center of mass. Assumed true if not present.

ExpTime

```
double? Umbrella2.Pipeline.ExtraIO.Ades.PhotometryGroup.ExpTime
```

Exposure time in seconds. Total exposure time in the case of stacked image detections.

FWHM

double? Umbrella2.Pipeline.ExtraIO.Ades.PhotometryGroup.FWHM

Size of seeing disc in arcseconds, measured at Full Width Half Maximum (FWHM) of target point spread function (PSF).

LogSNR

double? Umbrella2.Pipeline.ExtraIO.Ades.PhotometryGroup.LogSNR

Log10 of the signal-to-noise ratio of the source in the image integrated on the entire aperture used for the astrometric centroid.

Magnitude

double Umbrella2.Pipeline.ExtraIO.Ades.PhotometryGroup.Magnitude

Apparent Magnitude in specified band.

MpcBand

string Umbrella2.Pipeline.ExtraIO.Ades.PhotometryGroup.MpcBand

Filter designation for photometry.

NumStars

int? Umbrella2.Pipeline.ExtraIO.Ades.PhotometryGroup.NumStars

Number of reference stars in astrometric fit.

PhotometricCatalog

string Umbrella2.Pipeline.ExtraIO.Ades.PhotometryGroup.PhotometricCatalog

Star catalog used for photometry measurements.

RmsAstrometricFit

double? Umbrella2.Pipeline.ExtraIO.Ades.PhotometryGroup.RmsAstrometricFit

RMS of fit of astrometric comparison stars in arcseconds.

RmsMagnitude

```
double? Umbrella2.Pipeline.ExtraIO.Ades.PhotometryGroup.RmsMagnitude
```

Apparent magnitude 1 sigma uncertainty in magnitudes.

2.153 Umbrella2.Algorithms.Tools.PhotometryAperture.PhotometryMeasurementResult Struct Reference

Result of a photometric measurement.

Public Attributes

- double [UncorrectedObjectIntensity](#)
Raw intensity of the object, without subtracting the background intensities.
- int [FreePixels](#)
Number of pixels in the annular background aperture.
- int [ObjectPixels](#)
Number of pixels in the central, object aperture.
- double [CorrectedObjectIntensity](#)
Measured intensity of the object, corrected through the background intensities.
- double [LocalZeroLevel](#)
The background intensity around the object, as measured by the surrounding annular aperture.
- double [LocalStDev](#)
The standard deviation of the background, as measured by the surrounding annular aperture.
- double [StDevSurface](#)
Estimated standard deviation of the measured intensity, extrapolated from [LocalStDev](#).

2.153.1 Detailed Description

Result of a photometric measurement.

2.153.2 Member Data Documentation

CorrectedObjectIntensity

```
double Umbrella2.Algorithms.Tools.PhotometryAperture.PhotometryMeasurementResult.CorrectedObjectIntensity
```

Measured intensity of the object, corrected through the background intensities.

FreePixels

```
int Umbrella2.Algorithms.Tools.PhotometryAperture.PhotometryMeasurementResult.FreePixels
```

Number of pixels in the annular background aperture.

LocalStDev

```
double Umbrella2.Algorithms.Tools.PhotometryAperture.PhotometryMeasurementResult.LocalStDev
```

The standard deviation of the background, as measured by the surrounding annular aperture.

LocalZeroLevel

```
double Umbrella2.Algorithms.Tools.PhotometryAperture.PhotometryMeasurementResult.LocalZero↔  
Level
```

The background intensity around the object, as measured by the surrounding annular aperture.

ObjectPixels

```
int Umbrella2.Algorithms.Tools.PhotometryAperture.PhotometryMeasurementResult.ObjectPixels
```

Number of pixels in the central, object aperture.

StDevSurface

```
double Umbrella2.Algorithms.Tools.PhotometryAperture.PhotometryMeasurementResult.StDevSurface
```

Estimated standard deviation of the measured intensity, extrapolated from [LocalStDev](#).

UncorrectedObjectIntensity

```
double Umbrella2.Algorithms.Tools.PhotometryAperture.PhotometryMeasurementResult.Uncorrected↔  
ObjectIntensity
```

Raw intensity of the object, without subtracting the background intensities.

2.154 Umbrella2.PixelPoint Struct Reference

Point representing a pixel coordinate.

Public Member Functions

- override string [ToString](#) ()

Static Public Member Functions

- static double [operator^](#) (PixelPoint a, PixelPoint b)

Public Attributes

- double [X](#)
- double [Y](#)

2.154.1 Detailed Description

Point representing a pixel coordinate.

2.154.2 Member Function Documentation

`operator^()`

```
static double Umbrella2.PixelPoint.operator^ (  
    PixelPoint a,  
    PixelPoint b) [static]
```

`ToString()`

```
override string Umbrella2.PixelPoint.ToString ()
```

2.154.3 Member Data Documentation

`X`

```
double Umbrella2.PixelPoint.X
```

`Y`

```
double Umbrella2.PixelPoint.Y
```

2.155 Umbrella2.PixelVelocity Struct Reference

Velocity in pixel coordinates. Values in units per second.

Public Member Functions

- override string [ToString](#) ()

Static Public Member Functions

- static [operator double](#) ([PixelVelocity](#) pv)

Public Attributes

- double [Xvel](#)
X velocity in units per second.
- double [Yvel](#)
Y velocity in units per second.

Properties

- double [Magnitude](#) [get]
- double [Angle](#) [get]

2.155.1 Detailed Description

Velocity in pixel coordinates. Values in units per second.

2.155.2 Member Function Documentation

operator double()

```
static Umbrella2.PixelVelocity.operator double (  
    PixelVelocity pv) [explicit], [static]
```

ToString()

```
override string Umbrella2.PixelVelocity.ToString ()
```

2.155.3 Member Data Documentation

Xvel

```
double Umbrella2.PixelVelocity.Xvel
```

X velocity in units per second.

Yvel

```
double Umbrella2.PixelVelocity.Yvel
```

Y velocity in units per second.

2.155.4 Property Documentation

Angle

```
double Umbrella2.PixelVelocity.Angle [get]
```

Magnitude

```
double Umbrella2.PixelVelocity.Magnitude [get]
```

2.156 Umbrella2.Algorithms.Images.Normalization.Point4Distance Class Reference

An image brightness uniformization algorithm that interpolates background intensity by the distance to the points in a mesh of medians.

Public Member Functions

- [Point4Distance](#) (Image Input, Image Output, int MeshSize)

Public Attributes

- int [MeshSize](#)
Size of the median mesh.

Static Private Member Functions

- static void [RunMesh](#) (double[,] Input, ImageSegmentPosition Position, [Point4Distance](#) Mesh)
Mesh generation function.
- static void [Normalize](#) (double[,] Input, double[,] Output, ImageSegmentPosition InputPosition, ImageSegmentPosition OutputPosition, [Point4Distance](#) Mesh)
Output normalization function.

Private Attributes

- double[,] [MedianPoints](#)
Mesh of medians.
- [MTPool](#)< double[]> [Cached](#)
- [Image](#) Input
- [Image](#) Output
- [ImageStatistics](#) InputStat
- [PositionDependentExtractor](#)< [Point4Distance](#) > [MedianMesh](#) = [RunMesh](#)
- [PositionDependentMap](#)< [Point4Distance](#) > [Normalizer](#) = [Normalize](#)

2.156.1 Detailed Description

An image brightness uniformization algorithm that interpolates background intensity by the distance to the points in a mesh of medians.

2.156.2 Constructor & Destructor Documentation

Point4Distance()

```
Umbrella2.Algorithms.Images.Normalization.Point4Distance.Point4Distance (
    Image Input,
    Image Output,
    int MeshSize)
```

2.156.3 Member Function Documentation

Normalize()

```
static void Umbrella2.Algorithms.Images.Normalization.Point4Distance.Normalize (
    double Input[,],
    double Output[,],
    ImageSegmentPosition InputPosition,
    ImageSegmentPosition OutputPosition,
    Point4Distance Mesh) [static], [private]
```

Output normalization function.

RunMesh()

```
static void Umbrella2.Algorithms.Images.Normalization.Point4Distance.RunMesh (
    double Input[,],
    ImageSegmentPosition Position,
    Point4Distance Mesh) [static], [private]
```

Mesh generation function.

2.156.4 Member Data Documentation

Cached

```
MTPool<double[]> Umbrella2.Algorithms.Images.Normalization.Point4Distance.Cached [private]
```

Input

```
Image Umbrella2.Algorithms.Images.Normalization.Point4Distance.Input [private]
```

InputStat

```
ImageStatistics Umbrella2.Algorithms.Images.Normalization.Point4Distance.InputStat [private]
```

MedianMesh

```
PositionDependentExtractor<Point4Distance> Umbrella2.Algorithms.Images.Normalization.Point4Distance.MedianMesh = RunMesh [private]
```

MedianPoints

```
double [,] Umbrella2.Algorithms.Images.Normalization.Point4Distance.MedianPoints [private]
```

Mesh of medians.

MeshSize

```
int Umbrella2.Algorithms.Images.Normalization.Point4Distance.MeshSize
```

Size of the median mesh.

Normalizer

```
PositionDependentMap<Point4Distance> Umbrella2.Algorithms.Images.Normalization.Point4Distance.Normalizer = Normalize [private]
```

Output

```
Image Umbrella2.Algorithms.Images.Normalization.Point4Distance.Output [private]
```

2.157 Umbrella2.Algorithms.Detection.PoolMDMerger Class Reference

Holds detections and performs merging of source detections in tracklets.

Public Member Functions

- [PoolMDMerger](#) (DateTime[] ObservationTimes)
Initializes a new instance.
- void [LoadDetections](#) (List< [ImageDetection](#) > Detections)
Preloads detections into the search structures.
- void [GeneratePool](#) ()
Generates the search structures.
- bool [PairPossible](#) ([ImageDetection](#) a, [ImageDetection](#) b)
- void [TryPair](#) ([ImageDetection](#) a, [ImageDetection](#) b)
- void [TryPairDot](#) ([ImageDetection](#) a, [ImageDetection](#) b)
- List< [ImageDetection](#)[][] > [Search](#) ()
Searches for tracklets from the given sources.

Private Attributes

- [QuadTree](#)< [ImageDetection](#) > [DetectionPool](#)
- List< [ImageDetection](#) > [PoolList](#)
- double [Topmost](#)
- double [Lowermost](#)
- double [Leftmost](#)
- double [Rightmost](#)
- List< [DateTime](#) > [ObsTimes](#)
- double [LongTrailHighThreshold](#) = 30
- double [LongTrailLowThreshold](#) = 10
- double [AngleDistanceDifferenceThreshold](#) = 10
- List< [ImageDetection](#)[][]> [CandidatePairings](#)

Static Private Attributes

- const int [PoolDepth](#) = 10
- const double [MaxArcsecVDot](#) = 16
- const double [MinArcsecVDot](#) = 0.2
- static double [MaxVDD](#) = [MaxArcsecVDot](#) * Math.PI / 180 / 3600
- static double [MinVDD](#) = [MinArcsecVDot](#) * Math.PI / 180 / 3600

2.157.1 Detailed Description

Holds detections and performs merging of source detections in tracklets.

This code is a first-fit solution to the problem of detection merging. In particular, the search function and associates should be reimplemented with a carefully designed algorithm.

2.157.2 Constructor & Destructor Documentation

PoolMDMerger()

```
Umbrella2.Algorithms.Detection.PoolMDMerger.PoolMDMerger (
    DateTime[] ObservationTimes)
```

Initializes a new instance.

2.157.3 Member Function Documentation

GeneratePool()

```
void Umbrella2.Algorithms.Detection.PoolMDMerger.GeneratePool ()
```

Generates the search structures.

LoadDetections()

```
void Umbrella2.Algorithms.Detection.PoolMDMerger.LoadDetections (
    List< ImageDetection > Detections)
```

Preloads detections into the search structures.

Parameters

<i>Detections</i>	Detected sources.
-------------------	-------------------

PairPossible()

```
bool Umbrella2.Algorithms.Detection.PoolMDMerger.PairPossible (  
    ImageDetection a,  
    ImageDetection b)
```

Search()

```
List< ImageDetection[][]> Umbrella2.Algorithms.Detection.PoolMDMerger.Search ()
```

Searches for tracklets from the given sources.

Returns

TryPair()

```
void Umbrella2.Algorithms.Detection.PoolMDMerger.TryPair (  
    ImageDetection a,  
    ImageDetection b)
```

TryPairDot()

```
void Umbrella2.Algorithms.Detection.PoolMDMerger.TryPairDot (  
    ImageDetection a,  
    ImageDetection b)
```

2.157.4 Member Data Documentation

AngleDistanceDifferenceThreshold

```
double Umbrella2.Algorithms.Detection.PoolMDMerger.AngleDistanceDifferenceThreshold = 10 [private]
```

CandidatePairings

```
List<ImageDetection[][]> Umbrella2.Algorithms.Detection.PoolMDMerger.CandidatePairings [private]
```

DetectionPool

```
QuadTree<ImageDetection> Umbrella2.Algorithms.Detection.PoolMDMerger.DetectionPool [private]
```

Leftmost

```
double Umbrella2.Algorithms.Detection.PoolMDMerger.Leftmost [private]
```

LongTrailHighThreshold

```
double Umbrella2.Algorithms.Detection.PoolMDMerger.LongTrailHighThreshold = 30 [private]
```

LongTrailLowThreshold

```
double Umbrella2.Algorithms.Detection.PoolMDMerger.LongTrailLowThreshold = 10 [private]
```

Lowermost

```
double Umbrella2.Algorithms.Detection.PoolMDMerger.Lowermost [private]
```

MaxArcsecVDot

```
const double Umbrella2.Algorithms.Detection.PoolMDMerger.MaxArcsecVDot = 16 [static], [private]
```

MaxVDD

```
double Umbrella2.Algorithms.Detection.PoolMDMerger.MaxVDD = MaxArcsecVDot * Math.PI / 180 /  
3600 [static], [private]
```

MinArcsecVDot

```
const double Umbrella2.Algorithms.Detection.PoolMDMerger.MinArcsecVDot = 0.2 [static], [private]
```

MinVDD

```
double Umbrella2.Algorithms.Detection.PoolMDMerger.MinVDD = MinArcsecVDot * Math.PI / 180 /  
3600 [static], [private]
```

ObsTimes

```
List<DateTime> Umbrella2.Algorithms.Detection.PoolMDMerger.ObsTimes [private]
```

PoolDepth

```
const int Umbrella2.Algorithms.Detection.PoolMDMerger.PoolDepth = 10 [static], [private]
```

PoolList

```
List<ImageDetection> Umbrella2.Algorithms.Detection.PoolMDMerger.PoolList [private]
```

Rightmost

```
double Umbrella2.Algorithms.Detection.PoolMDMerger.Rightmost [private]
```

Topmost

```
double Umbrella2.Algorithms.Detection.PoolMDMerger.Topmost [private]
```

2.158 Umbrella2.Position Struct Reference

Represents an object position.

Public Member Functions

- [Position](#) ([EquatorialPoint](#) EqPoint, [PixelPoint](#) PixPoint)
Creates a new instance of given equatorial coordinates and image coordinates.

Static Public Member Functions

- static implicit [operator EquatorialPoint](#) ([Position](#) p)
Extracts the equatorial coordinates of a given position.
- static implicit [operator PixelPoint](#) ([Position](#) p)
Extracts the image coordinates of a given position.

Public Attributes

- readonly [EquatorialPoint](#) EP
The position in equatorial coordinates.
- readonly [PixelPoint](#) PP
The position in image coordinates.

2.158.1 Detailed Description

Represents an object position.

2.158.2 Constructor & Destructor Documentation

Position()

```
Umbrella2.Position.Position (  
    EquatorialPoint EqPoint,  
    PixelPoint PixPoint)
```

Creates a new instance of given equatorial coordinates and image coordinates.

Parameters

<i>EqPoint</i>	Equatorial coordinates.
<i>PixPoint</i>	Image coordinates.

2.158.3 Member Function Documentation

operator EquatorialPoint()

```
static implicit Umbrella2.Position.operator EquatorialPoint (  
    Position p) [static]
```

Extracts the equatorial coordinates of a given position.

operator PixelPoint()

```
static implicit Umbrella2.Position.operator PixelPoint (  
    Position p) [static]
```

Extracts the image coordinates of a given position.

2.158.4 Member Data Documentation

EP

```
readonly EquatorialPoint Umbrella2.Position.EP
```

The position in equatorial coordinates.

PP

```
readonly PixelPoint Umbrella2.Position.PP
```

The position in image coordinates.

2.159 Umbrella2.Pipeline.ExtraIO.Ades.PrecisionGroup Class Reference

For observations that were translated from MPC1992 or earlier formats, the Precision Group preserves the precision of the original reported observation and allows the content of the original sexagesimal submission to be derived. The entire group is optional (but not allowed in MPC submissions),.

Public Attributes

- long? [TimePrecision](#)
Precision in millionths of a day of the reported observation time for archived MPC1992 data records.
- decimal? [PrecisionRA](#)
Precision in seconds of the reported RA for archived MPC1992 data records.
- decimal? [PrecisionDec](#)
Precision in arcseconds of the reported DEC for archived MPC1992 data records.
- decimal? [TimeUncertainty](#)
Estimated time uncertainty in seconds. Unlike the preceding RMS fields, which indicate random errors, this field indicates a presumed level of systematic clock error.
- string [Notes](#)
A set of one-character note flags to communicate observing circumstances.
- string[] [Remarks](#)
Comment field provided by the observer. This field can be used to report additional information that is not reportable in the notes field, but that may be of relevance for interpretation of the observations.
- string [ObsIsDeprecated](#)
Marks deprecated observation. This field, if present, indicates a deprecated observation that is preserved for historical purposes, but is not to be used for orbit fitting. 'X' is the only permitted value.

2.159.1 Detailed Description

For observations that were translated from MPC1992 or earlier formats, the Precision Group preserves the precision of the original reported observation and allows the content of the original sexagesimal submission to be derived. The entire group is optional (but not allowed in MPC submissions),.

2.159.2 Member Data Documentation

Notes

```
string Umbrella2.Pipeline.ExtraIO.Ades.PrecisionGroup.Notes
```

A set of one-character note flags to communicate observing circumstances.

ObsIsDeprecated

```
string Umbrella2.Pipeline.ExtraIO.Ades.PrecisionGroup.ObsIsDeprecated
```

Marks deprecated observation. This field, if present, indicates a deprecated observation that is preserved for historical purposes, but is not to be used for orbit fitting. 'X' is the only permitted value.

PrecisionDec

```
decimal? Umbrella2.Pipeline.ExtraIO.Ades.PrecisionGroup.PrecisionDec
```

Precision in arcseconds of the reported DEC for archived MPC1992 data records.

PrecisionRA

```
decimal? Umbrella2.Pipeline.ExtraIO.Ades.PrecisionGroup.PrecisionRA
```

Precision in seconds of the reported RA for archived MPC1992 data records.

Remarks

```
string [] Umbrella2.Pipeline.ExtraIO.Ades.PrecisionGroup.Remarks
```

[Comment](#) field provided by the observer. This field can be used to report additional information that is not reportable in the notes field, but that may be of relevance for interpretation of the observations.

TimePrecision

```
long? Umbrella2.Pipeline.ExtraIO.Ades.PrecisionGroup.TimePrecision
```

Precision in millionths of a day of the reported observation time for archived MPC1992 data records.

TimeUncertainty

```
decimal? Umbrella2.Pipeline.ExtraIO.Ades.PrecisionGroup.TimeUncertainty
```

Estimated time uncertainty in seconds. Unlike the preceding RMS fields, which indicate random errors, this field indicates a presumed level of systematic clock error.

NB: This field is generally only to be used to communicate exceptions and problems with clock calibration and is not intended to be used in routine submissions where clock errors are not a significant source of astrometric error.

2.160 Umbrella2.Algorithms.Pairing.PrePair Class Reference

Attempts to merge detections that appear to be the same object.

Static Public Member Functions

- static void [MatchDetections](#) (List< [ImageDetection](#) > RawDetections, double MaxDistance, int MixMatch, double PSFMatch)
Match detections and merge those that seem to belong to the same object.

2.160.1 Detailed Description

Attempts to merge detections that appear to be the same object.

2.160.2 Member Function Documentation

MatchDetections()

```
static void Umbrella2.Algorithms.Pairing.PrePair.MatchDetections (
    List< ImageDetection > RawDetections,
    double MaxDistance,
    int MixMatch,
    double PSFMatch) [static]
```

Match detections and merge those that seem to belong to the same object.

Parameters

<i>RawDetections</i>	Input set of detections.
<i>MaxDistance</i>	Maximum distance possible between two detections part of the same object.
<i>MixMatch</i>	Number of overlapping pixels before two detections are considered part of the same object.
<i>PSFMatch</i>	Distance between the barycenters of 2 detections before they are considered the same (for external detections mostly).

2.161 Umbrella2.WCS.ProjectionAttribute Class Reference

Attribute for recognizing [WCS](#) projection algorithms.

Public Member Functions

- [ProjectionAttribute](#) (string *ProjectionTag*, string *ProjectionDescription*)

Public Attributes

- readonly string [Name](#)
Name tag of the projection.
- readonly string [Description](#)
Description text of the projection.

2.161.1 Detailed Description

Attribute for recognizing [WCS](#) projection algorithms.

2.161.2 Constructor & Destructor Documentation

ProjectionAttribute()

```
Umbrella2.WCS.ProjectionAttribute.ProjectionAttribute (
    string ProjectionTag,
    string ProjectionDescription)
```

2.161.3 Member Data Documentation

Description

```
readonly string Umbrella2.WCS.ProjectionAttribute.Description
```

Description text of the projection.

Name

```
readonly string Umbrella2.WCS.ProjectionAttribute.Name
```

Name tag of the projection.

2.162 Umbrella2.ProjectionPoint Struct Reference

Point representing a projection plane coordinate.

Public Attributes

- double [X](#)
- double [Y](#)

2.162.1 Detailed Description

Point representing a projection plane coordinate.

The standard units of [ProjectionPoint](#) are radians.

2.162.2 Member Data Documentation**X**

```
double Umbrella2.ProjectionPoint.X
```

Y

```
double Umbrella2.ProjectionPoint.Y
```

2.163 Umbrella2.ProjectionVelocity Struct Reference

Velocity in projection plane coordinates.

Public Attributes

- double [X](#)
- double [Y](#)

2.163.1 Detailed Description

Velocity in projection plane coordinates.

The standard units of [ProjectionVelocity](#) are radians per second.

2.163.2 Member Data Documentation

X

```
double Umbrella2.ProjectionVelocity.X
```

Y

```
double Umbrella2.ProjectionVelocity.Y
```

2.164 Umbrella2.PropertyModel.PropertyDescriptionAttribute Class Reference

Attribute marks a user-visible property or field.

Public Member Functions

- [PropertyDescriptionAttribute](#) (bool [ParseDocumentation](#))
- [PropertyDescriptionAttribute](#) (string [Name](#))
- [PropertyDescriptionAttribute](#) (string [Name=""](#), string [Description=""](#))

Public Attributes

- readonly string [Name](#)
Property name.
- readonly string [Description](#)
Description of the property to show on demand.
- readonly bool [ParseDocumentation](#)
Whether the Name and Description should be populated from the XML code documentation.

2.164.1 Detailed Description

Attribute marks a user-visible property or field.

2.164.2 Constructor & Destructor Documentation

PropertyDescriptionAttribute() [1/3]

```
Umbrella2.PropertyModel.PropertyDescriptionAttribute.PropertyDescriptionAttribute (  
    bool ParseDocumentation)
```

PropertyDescriptionAttribute() [2/3]

```
Umbrella2.PropertyModel.PropertyDescriptionAttribute.PropertyDescriptionAttribute (  
    string Name)
```

PropertyDescriptionAttribute() [3/3]

```
Umbrella2.PropertyModel.PropertyDescriptionAttribute.PropertyDescriptionAttribute (  
    string Name = "",  
    string Description = "")
```

2.164.3 Member Data Documentation**Description**

```
readonly string Umbrella2.PropertyModel.PropertyDescriptionAttribute.Description
```

Description of the property to show on demand.

Name

```
readonly string Umbrella2.PropertyModel.PropertyDescriptionAttribute.Name
```

Property name.

ParseDocumentation

```
readonly bool Umbrella2.PropertyModel.PropertyDescriptionAttribute.ParseDocumentation
```

Whether the Name and Description should be populated from the XML code documentation.

2.165 Umbrella2.PropertyModel.PropertyListAttribute Class Reference

Indicates a field is in fact a list of properties (of the original object).

Public Member Functions

- [PropertyListAttribute](#) ()

2.165.1 Detailed Description

Indicates a field is in fact a list of properties (of the original object).

2.165.2 Constructor & Destructor Documentation**PropertyListAttribute()**

```
Umbrella2.PropertyModel.PropertyListAttribute.PropertyListAttribute ()
```

2.166 Umbrella2.Visualizer.WinForms.PropertyViewer Class Reference

Provides a mechanism for viewing all the IExtensionProperty attached to given objects.

Classes

- struct [ShownDocumentation](#)
XML strings for the given documented element.

Public Member Functions

- [PropertyViewer](#) (Dictionary< string, List< [IExtensionProperty](#) > > PropSet)
Initializes a new instance with the given set of properties.
- [PropertyViewer](#) ([IExtendable](#) Object)
Initializes a new instance with properties from the given Object .
- [PropertyViewer](#) (string ObjName, [IExtendable](#) Object)
Initializes a new instance with properties from the given Object , with the given name.
- void [AddProperties](#) (string Object, params [IExtensionProperty](#)[] Props)
Adds properties to an existing object.
- void [AddObject](#) (string ObjName, [IExtendable](#) Obj)
Adds an object to the list of displayed objects.
- void [ShowProperties](#) ()
Creates the property tree.

Protected Member Functions

- override void [Dispose](#) (bool disposing)
Clean up any resources being used.

Private Member Functions

- [PropertyViewer](#) ()
- void [TreeView1_AfterSelect](#) (object sender, [TreeViewEventArgs](#) e)
Shows the documentation of a given node (where possible).
- void [InitializeComponent](#) ()
Required method for Designer support - do not modify the contents of this method with the code editor.
- void [DrawMember](#) ([MemberInfo](#) minfo, [TreeNode](#) Parent, object Obj)
Draws a field/property.
- void [TreeView1_BeforeExpand](#) (object sender, [TreeViewCancelEventArgs](#) e)
Dynamic tree generator.
- void [DrawObject](#) (object Obj, [TreeNode](#) Parent, [BindingPolicy](#) Policy)
Draws the object in the tree.
- delegate [BindingFlags](#) [BindingPolicy](#) (Type t)
Selects which members should be shown for a given type.
- [ShownDocumentation](#) [OpenDocumentation](#) ([System.Reflection.MemberInfo](#) mi)
Attempts to find documentation for a given type member.
- [ShownDocumentation](#) [OpenDocumentation](#) (Type t)
Attempts to find documentation for a given type.
- string [SeeReplaceEvaluator](#) ([Match](#) m)
Evaluates replacements for see nodes.
- string [RTFReplaceSee](#) (string Input)
Replaces sees from XML input to RTF output.

Static Private Member Functions

- static string [GetText](#) ([ShownDocumentation](#) doc)
- static bool [GetValue](#) (MemberInfo minfo, object Obj, out object Value)
If the input is field/property, gets the value and returns true.
- static System.Type [GetType](#) (MemberInfo minfo)
Returns the type of the field/property.
- static string [Format](#) (string Name, object Value)
Formats the given Name - Value pair for display in the tree.
- static BindingFlags [UmbrellaBindingPolicy](#) (Type t)
Umbrella default binding policy. Shows all members of [Umbrella2](#) objects and public ones of external objects.
- static string [GetXMLDocFilePath](#) (Type t)
Tries to compute the path to documentation for a given type.

Private Attributes

- Dictionary< string, List< [IExtensionProperty](#) > > [MultiObjectProperties](#)
The top level set of objects for which to display properties.
- System.ComponentModel.IContainer [components](#) = null
Required designer variable.
- System.Windows.Forms.TreeView [treeView1](#)
- System.Windows.Forms.RichTextBox [richTextBox1](#)
- Dictionary< TreeNode, MemberInfo > [Members](#)

Static Private Attributes

- const string [PlaceHolderText](#) = "_xPHD"
- static BindingFlags [UmbrellaFlags](#) = BindingFlags.NonPublic | BindingFlags.Public | BindingFlags.Instance
- static BindingFlags [ExternalFlags](#) = BindingFlags.Public | BindingFlags.Instance
- static readonly Regex [SeeNode](#) = new Regex("<see .*/>", RegexOptions.Compiled)
Regex for matching XML see nodes in documentation.

2.166.1 Detailed Description

Provides a mechanism for viewing all the [IExtensionProperty](#) attached to given objects.

2.166.2 Constructor & Destructor Documentation

PropertyViewer() [1/4]

```
Umbrella2.Visualizer.WinForms.PropertyViewer.PropertyViewer () [private]
```

PropertyViewer() [2/4]

```
Umbrella2.Visualizer.WinForms.PropertyViewer.PropertyViewer (
    Dictionary< string, List< IExtensionProperty > > PropSet)
```

Initializes a new instance with the given set of properties.

PropertyViewer() [3/4]

```
Umbrella2.Visualizer.WinForms.PropertyViewer.PropertyViewer (  
    IExtendable Object)
```

Initializes a new instance with properties from the given *Object* .

PropertyViewer() [4/4]

```
Umbrella2.Visualizer.WinForms.PropertyViewer.PropertyViewer (  
    string ObjName,  
    IExtendable Object)
```

Initializes a new instance with properties from the given *Object* , with the given name.

2.166.3 Member Function Documentation**AddObject()**

```
void Umbrella2.Visualizer.WinForms.PropertyViewer.AddObject (  
    string ObjName,  
    IExtendable Obj)
```

Adds an object to the list of displayed objects.

AddProperties()

```
void Umbrella2.Visualizer.WinForms.PropertyViewer.AddProperties (  
    string Object,  
    params IExtensionProperty[] Props)
```

Adds properties to an existing object.

BindingPolicy()

```
delegate BindingFlags Umbrella2.Visualizer.WinForms.PropertyViewer.BindingPolicy (  
    Type t) [private]
```

Selects which members should be shown for a given type.

Dispose()

```
override void Umbrella2.Visualizer.WinForms.PropertyViewer.Dispose (  
    bool disposing) [protected]
```

Clean up any resources being used.

Parameters

<i>disposing</i>	true if managed resources should be disposed; otherwise, false.
------------------	---

DrawMember()

```
void Umbrella2.Visualizer.WinForms.PropertyViewer.DrawMember (
    MemberInfo minfo,
    TreeNode Parent,
    object Obj) [private]
```

Draws a field/property.

DrawObject()

```
void Umbrella2.Visualizer.WinForms.PropertyViewer.DrawObject (
    object Obj,
    TreeNode Parent,
    BindingPolicy Policy) [private]
```

Draws the object in the tree.

Parameters

<i>Obj</i>	Object to draw.
<i>Parent</i>	Parent node.
<i>Policy</i>	The policy for selecting displayed members.

Format()

```
static string Umbrella2.Visualizer.WinForms.PropertyViewer.Format (
    string Name,
    object Value) [static], [private]
```

Formats the given *Name* - *Value* pair for display in the tree.

GetText()

```
static string Umbrella2.Visualizer.WinForms.PropertyViewer.GetText (
    ShownDocumentation doc) [static], [private]
```

GetType()

```
static System.Type Umbrella2.Visualizer.WinForms.PropertyViewer.GetType (
    MemberInfo minfo) [static], [private]
```

Returns the type of the field/property.

GetValue()

```
static bool Umbrella2.Visualizer.WinForms.PropertyViewer.GetValue (
    MemberInfo minfo,
    object Obj,
    out object Value) [static], [private]
```

If the input is field/property, gets the value and returns true.

GetXMLDocFilePath()

```
static string Umbrella2.Visualizer.WinForms.PropertyViewer.GetXMLDocFilePath (
    Type t) [static], [private]
```

Tries to compute the path to documentation for a given type.

InitializeComponent()

```
void Umbrella2.Visualizer.WinForms.PropertyViewer.InitializeComponent () [private]
```

Required method for Designer support - do not modify the contents of this method with the code editor.

OpenDocumentation() [1/2]

```
ShownDocumentation Umbrella2.Visualizer.WinForms.PropertyViewer.OpenDocumentation (
    System.Reflection.MemberInfo mi) [private]
```

Attempts to find documentation for a given type member.

OpenDocumentation() [2/2]

```
ShownDocumentation Umbrella2.Visualizer.WinForms.PropertyViewer.OpenDocumentation (
    Type t) [private]
```

Attempts to find documentation for a given type.

RTFReplaceSee()

```
string Umbrella2.Visualizer.WinForms.PropertyViewer.RTFReplaceSee (
    string Input) [private]
```

Replaces sees from XML input to RTF output.

SeeReplaceEvaluator()

```
string Umbrella2.Visualizer.WinForms.PropertyViewer.SeeReplaceEvaluator (
    Match m) [private]
```

Evaluates replacements for see nodes.

ShowProperties()

```
void Umbrella2.Visualizer.WinForms.PropertyViewer.ShowProperties ()
```

Creates the property tree.

TreeView1_AfterSelect()

```
void Umbrella2.Visualizer.WinForms.PropertyViewer.TreeView1_AfterSelect (  
    object sender,  
    TreeViewEventArgs e) [private]
```

Shows the documentation of a given node (where possible).

TreeView1_BeforeExpand()

```
void Umbrella2.Visualizer.WinForms.PropertyViewer.TreeView1_BeforeExpand (  
    object sender,  
    TreeViewCancelEventArgs e) [private]
```

Dynamic tree generator.

UmbrellaBindingPolicy()

```
static BindingFlags Umbrella2.Visualizer.WinForms.PropertyViewer.UmbrellaBindingPolicy (  
    Type t) [static], [private]
```

Umbrella default binding policy. Shows all members of [Umbrella2](#) objects and public ones of external objects.

2.166.4 Member Data Documentation

components

```
System.ComponentModel.IContainer Umbrella2.Visualizer.WinForms.PropertyViewer.components =  
null [private]
```

Required designer variable.

ExternalFlags

```
BindingFlags Umbrella2.Visualizer.WinForms.PropertyViewer.ExternalFlags = BindingFlags.Public |  
BindingFlags.Instance [static], [private]
```

Members

```
Dictionary<TreeNode, MemberInfo> Umbrella2.Visualizer.WinForms.PropertyViewer.Members [private]
```

MultiObjectProperties

```
Dictionary<string, List<IExtensionProperty> > Umbrella2.Visualizer.WinForms.PropertyViewer.↔  
MultiObjectProperties [private]
```

The top level set of objects for which to display properties.

PlaceholderText

```
const string Umbrella2.Visualizer.WinForms.PropertyViewer.PlaceHolderText = "_xPHD" [static],  
[private]
```

richTextBox1

```
System.Windows.Forms.RichTextBox Umbrella2.Visualizer.WinForms.PropertyViewer.richTextBox1  
[private]
```

SeeNode

```
readonly Regex Umbrella2.Visualizer.WinForms.PropertyViewer.SeeNode = new Regex("<see .*/>",  
RegexOptions.Compiled) [static], [private]
```

Regex for matching XML see nodes in documentation.

treeView1

```
System.Windows.Forms.TreeView Umbrella2.Visualizer.WinForms.PropertyViewer.treeView1 [private]
```

UmbrellaFlags

```
BindingFlags Umbrella2.Visualizer.WinForms.PropertyViewer.UmbrellaFlags = BindingFlags.Non↔  
Public | BindingFlags.Public | BindingFlags.Instance [static], [private]
```

2.167 Umbrella2.Algorithms.Misc.QuadTree< T > Class Template Reference

A [QuadTree](#) (2-d tree) for quickly identifying objects in a given neighborhood.

Classes

- class [QuadTreeNode](#)
Node of the [QuadTree](#).

Public Member Functions

- [QuadTree](#) (int [Depth](#), double *Top*, double *Bottom*, double *Left*, double *Right*)
Creates a new QuadTree of given position, size and depth.
- void [Add](#) (T *Object*, double *X*, double *Y*)
Adds a new object to the tree.
- List< T > [Query](#) (double *Top*, double *Bottom*, double *Left*, double *Right*)
Queries the tree for objects in a given area.
- List< T > [Query](#) (double *X*, double *Y*, double *SquareSemiside*)
Queries the tree for objects around a given point.

Private Attributes

- readonly int [Depth](#)
Tree depth.
- readonly [QuadTreeNode](#) [Root](#)
Tree root.

2.167.1 Detailed Description

A [QuadTree](#) (2-d tree) for quickly identifying objects in a given neighborhood.

Template Parameters

<i>T</i>	The objects held by the QuadTree .
----------	--

2.167.2 Constructor & Destructor Documentation

QuadTree()

```
Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTree (
    int Depth,
    double Top,
    double Bottom,
    double Left,
    double Right)
```

Creates a new [QuadTree](#) of given position, size and depth.

Parameters

<i>Depth</i>	Tree depth. Number of branches to the lowest object bucket.
<i>Top</i>	Topmost Y coordinate of tree.
<i>Bottom</i>	Bottommost Y coordinate of tree.
<i>Left</i>	Leftmost X coordinate of the tree.
<i>Right</i>	Rightmost X coordinate of the tree.

2.167.3 Member Function Documentation

Add()

```
void Umbrella2.Algorithms.Misc.QuadTree< T >.Add (
    T Object,
    double X,
    double Y)
```

Adds a new object to the tree.

Parameters

<i>Object</i>	Object to be added.
<i>X</i>	The X coordinate of the object.
<i>Y</i>	The Y coordinate of the object.

Query() [1/2]

```
List< T > Umbrella2.Algorithms.Misc.QuadTree< T >.Query (
    double Top,
    double Bottom,
    double Left,
    double Right)
```

Queries the tree for objects in a given area.

Parameters

<i>Top</i>	Top (smallest) Y coordinate.
<i>Bottom</i>	Bottom (largest) Y coordinate.
<i>Left</i>	Left X coordinate.
<i>Right</i>	Right X coordinate.

Returns

Query() [2/2]

```
List< T > Umbrella2.Algorithms.Misc.QuadTree< T >.Query (
    double X,
    double Y,
    double SquareSemiside)
```

Queries the tree for objects around a given point.

Parameters

<i>X</i>	X coordinate of the center of the square.
<i>Y</i>	Y coordinate of the center of the square.
<i>SquareSemiside</i>	Distance from the center to the edges of the square.

Returns

2.167.4 Member Data Documentation

Depth

```
readonly int Umbrella2.Algorithms.Misc.QuadTree< T >.Depth [private]
```

Tree depth.

Root

```
readonly QuadTreeNode Umbrella2.Algorithms.Misc.QuadTree< T >.Root [private]
```

Tree root.

2.168 Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.QuadTreeNode Class Reference

Node of the QuadTree.

Public Member Functions

- [QuadTreeNode](#) (double Top, double Bottom, double Left, double Right)
- void [Query](#) (double Top, double Bottom, double Left, double Right, List< T > Accumulator)

Recursively queries the tree for objects.

Package Attributes

- readonly double [Tp](#)
- readonly double [Bt](#)
- readonly double [Lf](#)
- readonly double [Rg](#)
- [QuadTreeNode](#) nTL
- [QuadTreeNode](#) nTR
- [QuadTreeNode](#) nBL
- [QuadTreeNode](#) nBR
- List< T > [Bucket](#)

Object bucket.

2.168.1 Detailed Description

Node of the QuadTree.

2.168.2 Constructor & Destructor Documentation

QuadTreeNode()

```
Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.QuadTreeNode.QuadTreeNode (
    double Top,
    double Bottom,
    double Left,
    double Right)
```

Parameters

<i>Top</i>	Top Y coordinate of node area.
<i>Bottom</i>	Bottom Y coordinate of the node area.
<i>Left</i>	Left X coordinate of the node area.
<i>Right</i>	Right X coordinate of the node area.

2.168.3 Member Function Documentation

Query()

```
void Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.QuadTreeNode.Query (
    double Top,
    double Bottom,
    double Left,
    double Right,
    List< T > Accumulator)
```

Recursively queries the tree for objects.

Parameters

<i>Top</i>	Top Y coordinate of the search area.
<i>Bottom</i>	Bottom Y coordinate of the search area.
<i>Left</i>	Left X coordinate of the search area.
<i>Right</i>	Right X coordinate of the search area.
<i>Accumulator</i>	

2.168.4 Member Data Documentation

Bt

```
readonly double Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.QuadTreeNode.Bt
[package]
```


Bucket

List<T> [Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.QuadTreeNode.Bucket](#) [package]

Object bucket.

Lf

readonly double [Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.QuadTreeNode.Lf](#)
[package]

nBL

[QuadTreeNode Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.QuadTreeNode.nBL](#)
[package]

nBR

[QuadTreeNode Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.QuadTreeNode.nBR](#)
[package]

nTL

[QuadTreeNode Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.QuadTreeNode.nTL](#)
[package]

nTR

[QuadTreeNode Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.QuadTreeNode.nTR](#)
[package]

Rg

readonly double [Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.QuadTreeNode.Rg](#)
[package]

Tp

readonly double [Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.QuadTreeNode.Tp](#)
[package]

2.169 Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTreeNode Class Reference

Node of the [QuadTree](#).

Public Member Functions

- [QuadTreeNode](#) (double Top, double Bottom, double Left, double Right)
- void [Query](#) (double Top, double Bottom, double Left, double Right, List< T > Accumulator)
Recursively queries the tree for objects.

Package Attributes

- readonly double [Tp](#)
- readonly double [Bt](#)
- readonly double [Lf](#)
- readonly double [Rg](#)
- [QuadTreeNode](#) nTL
- [QuadTreeNode](#) nTR
- [QuadTreeNode](#) nBL
- [QuadTreeNode](#) nBR
- List< T > [Bucket](#)
Object bucket.

2.169.1 Detailed Description

Node of the [QuadTree](#).

2.169.2 Constructor & Destructor Documentation

QuadTreeNode()

```
Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTreeNode.QuadTreeNode (
    double Top,
    double Bottom,
    double Left,
    double Right)
```

Parameters

<i>Top</i>	Top Y coordinate of node area.
<i>Bottom</i>	Bottom Y coordinate of the node area.
<i>Left</i>	Left X coordinate of the node area.
<i>Right</i>	Right X coordinate of the node area.

2.169.3 Member Function Documentation

Query()

```
void Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTreeNode.Query (
    double Top,
    double Bottom,
    double Left,
    double Right,
    List< T > Accumulator)
```

Recursively queries the tree for objects.

Parameters

<i>Top</i>	Top Y coordinate of the search area.
<i>Bottom</i>	Bottom Y coordinate of the search area.
<i>Left</i>	Left X coordinate of the search area.
<i>Right</i>	Right X coordinate of the search area.
<i>Accumulator</i>	

2.169.4 Member Data Documentation

Bt

readonly double [Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTreeNode.Bt](#) [package]

Bucket

List<T> [Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTreeNode.Bucket](#) [package]

Object bucket.

Lf

readonly double [Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTreeNode.Lf](#) [package]

nBL

[QuadTreeNode Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTreeNode.nBL](#) [package]

nBR

[QuadTreeNode Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTreeNode.nBR](#) [package]

nTL

[QuadTreeNode Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTreeNode.nTL](#) [package]

nTR

[QuadTreeNode Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTreeNode.nTR](#) [package]

Rg

readonly double [Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTreeNode.Rg](#) [package]

Tp

```
readonly double Umbrella2.Algorithms.Misc.QuadTree< T >.QuadTreeNode.Tp [package]
```

2.170 Umbrella2.Pipeline.ExtraIO.Vizier.QueryEngine Class Reference

Engine for querying [VizieR](#).

Static Public Member Functions

- static string [GenerateQueryBaseUrl](#) ([QueryParams](#) Params)
Generates a base URL for queries, which may be used for querying different positions and radii.
- static string [GenerateQueryUrl](#) (string BaseUrl, [EquatorialPoint](#) Center, double Radius)
Generates the query URL, starting from a base URL produced through [GenerateQueryBaseUrl\(QueryParams\)](#).
- static List< [VizieR.StarInfo](#) > [Query](#) ([QueryParams](#) Params, [EquatorialPoint](#) Center, double Radius, double LowMagLimit)
Simple query function, without caching.

2.170.1 Detailed Description

Engine for querying [VizieR](#).

2.170.2 Member Function Documentation**GenerateQueryBaseUrl()**

```
static string Umbrella2.Pipeline.ExtraIO.Vizier.QueryEngine.GenerateQueryBaseUrl (
    QueryParams Params) [static]
```

Generates a base URL for queries, which may be used for querying different positions and radii.

Returns

The base URL for the subsequent queries.

Parameters

<i>Params</i>	Parameters to generate from.
---------------	------------------------------

GenerateQueryUrl()

```
static string Umbrella2.Pipeline.ExtraIO.Vizier.QueryEngine.GenerateQueryUrl (
    string BaseUrl,
    EquatorialPoint Center,
    double Radius) [static]
```

Generates the query URL, starting from a base URL produced through [GenerateQueryBaseUrl\(QueryParams\)](#).

Returns

The query URL.

Parameters

<i>BaseUrl</i>	Base URL.
<i>Center</i>	Center of the query region.
<i>Radius</i>	Radius of the cone to search.

Query()

```
static List< VizieR.StarInfo > Umbrella2.Pipeline.ExtraIO.Vizier.QueryEngine.Query (
    QueryParams Params,
    EquatorialPoint Center,
    double Radius,
    double LowMagLimit) [static]
```

Simple query function, without caching.

Returns

The list of stars matching the search criteria.

Parameters

<i>Params</i>	Parameters for the VizieR query.
<i>Center</i>	Center of the query region.
<i>Radius</i>	Radius of the cone to search.
<i>LowMagLimit</i>	Maximum magnitude to return.

2.171 Umbrella2.Pipeline.ExtraIO.Vizier.QueryParams Struct Reference

Parameters for the [VizieR](#) query.

Public Attributes

- string [BaseUrl](#)
Base URL for the query, for selecting different servers.
- [IVizierParser](#) Parser
Parser to use. Different parsers may provide different data.
- string [Order](#)
Parameter to order by.
- bool [Increasing](#)
Whether the order is increasing or decreasing.
- string [Equinox](#)
Equinox of the coordinate system.
- string [Catalog](#)
Catalogue to query, in [VizieR](#) notation.
- int [MaxObjects](#)
Maximum number of objects to return.

2.171.1 Detailed Description

Parameters for the [VizieR](#) query.

2.171.2 Member Data Documentation

BaseUrl

```
string Umbrella2.Pipeline.ExtraIO.VizieR.QueryParams.BaseUrl
```

Base URL for the query, for selecting different servers.

Catalog

```
string Umbrella2.Pipeline.ExtraIO.VizieR.QueryParams.Catalog
```

Catalogue to query, in [VizieR](#) notation.

Equinox

```
string Umbrella2.Pipeline.ExtraIO.VizieR.QueryParams.Equinox
```

Equinox of the coordinate system.

Increasing

```
bool Umbrella2.Pipeline.ExtraIO.VizieR.QueryParams.Increasing
```

Whether the order is increasing or decreasing.

MaxObjects

```
int Umbrella2.Pipeline.ExtraIO.VizieR.QueryParams.MaxObjects
```

Maximum number of objects to return.

Order

```
string Umbrella2.Pipeline.ExtraIO.VizieR.QueryParams.Order
```

Parameter to order by.

Parser

```
IVizieRParser Umbrella2.Pipeline.ExtraIO.VizieR.QueryParams.Parser
```

Parser to use. Different parsers may provide different data.

2.172 Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup Class Reference

The optical residuals group allows exchange of orbital residuals, astrometric, photometric, or both.

Public Attributes

- string [OrbitProducer](#)
Orbit producer. Can be institution, individual, or even email address, e.g. 'MPC'.
- string [OrbitID](#)
Local reference for orbit, e.g., 'JPL 7' or 'MPO 12345'.
- double? [ResidualsRA](#)
*Residuals in $RA * \cos(Dec)$ in arcseconds.*
- double? [ResidualsDec](#)
Residuals in Dec in arcseconds.
- string [AstrometrySelection](#)
Inclusion/rejection flag for astrometry. 'A' or 'D' for automatic accept/delete. /// 'a' or 'd' for forced accept/delete.
- double? [UncertaintyRA](#)
*Adopted $RA * \cos(Dec)$ 1 sigma uncertainty in arcseconds.*
- double? [UncertaintyDec](#)
Adopted Dec 1 sigma uncertainty in arcseconds.
- double? [CorrelationRADec](#)
Adopted correlation between [UncertaintyRA](#) and [UncertaintyDec](#).
- double? [UncertaintyTime](#)
Adopted 1 sigma time uncertainty in seconds.
- double? [BiasRA](#)
*Adopted $RA * \cos(Dec)$ 1 sigma bias in arcseconds.*
- double? [BiasDec](#)
Adopted Dec 1 sigma bias in arcseconds.
- double? [TimeBias](#)
Adopted time bias in seconds.
- string [PhotometryProducer](#)
Producer of photometric residuals. Can be institution, individual, or even email address, e.g. 'MPC'.
- double? [ResidualMagnitude](#)
Photometric residual in magnitudes.
- string [PhotometrySelection](#)
Inclusion/rejection flag for photometry. 'A' or 'D' for automatic accept/delete. 'a' or 'd' for forced accept/delete.
- double? [UncertaintyMagnitude](#)
Adopted 1 sigma magnitude uncertainty in magnitudes.
- double? [BiasMagnitude](#)
Adopted photometric bias in magnitudes.
- string [PhotometricModel](#)
Description of the photometric model.

2.172.1 Detailed Description

The optical residuals group allows exchange of orbital residuals, astrometric, photometric, or both.

2.172.2 Member Data Documentation

AstrometrySelection

```
string Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.AstrometrySelection
```

Inclusion/rejection flag for astrometry. 'A' or 'D' for automatic accept/delete. /// 'a' or 'd' for forced accept/delete.

BiasDec

```
double? Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.BiasDec
```

Adopted Dec 1 sigma bias in arcseconds.

BiasMagnitude

```
double? Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.BiasMagnitude
```

Adopted photometric bias in magnitudes.

BiasRA

```
double? Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.BiasRA
```

Adopted $RA * \cos(Dec)$ 1 sigma bias in arcseconds.

CorrelationRADec

```
double? Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.CorrelationRADec
```

Adopted correlation between [UncertaintyRA](#) and [UncertaintyDec](#).

OrbitID

```
string Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.OrbitID
```

Local reference for orbit, e.g., 'JPL 7' or 'MPO 12345'.

OrbitProducer

```
string Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.OrbitProducer
```

Orbit producer. Can be institution, individual, or even email address, e.g. 'MPC'.

PhotometricModel

```
string Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.PhotometricModel
```

Description of the photometric model.

- H: H-G system with $G = 0.15$
- HG: H-G with different value of G
- HG1G2: H-G1-G2 system
- HG12: H-G12 system
- NEATM: NEA Thermal Model
- FRM: Fast Rotator Model

PhotometryProducer

```
string Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.PhotometryProducer
```

Producer of photometric residuals. Can be institution, individual, or even email address, e.g. 'MPC'.

PhotometrySelection

```
string Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.PhotometrySelection
```

Inclusion/rejection flag for photometry. 'A' or 'D' for automatic accept/delete. 'a' or 'd' for forced accept/delete.

ResidualMagnitude

```
double? Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.ResidualMagnitude
```

Photometric residual in magnitudes.

ResidualsDec

```
double? Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.ResidualsDec
```

Residuals in Dec in arcseconds.

ResidualsRA

```
double? Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.ResidualsRA
```

Residuals in $RA * \cos(\text{Dec})$ in arcseconds.

TimeBias

`double? Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.TimeBias`

Adopted time bias in seconds.

UncertaintyDec

`double? Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.UncertaintyDec`

Adopted Dec 1 sigma uncertainty in arcseconds.

UncertaintyMagnitude

`double? Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.UncertaintyMagnitude`

Adopted 1 sigma magnitude uncertainty in magnitudes.

UncertaintyRA

`double? Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.UncertaintyRA`

Adopted $RA * \cos(Dec)$ 1 sigma uncertainty in arcseconds.

UncertaintyTime

`double? Umbrella2.Pipeline.ExtraIO.Ades.ResidualsGroup.UncertaintyTime`

Adopted 1 sigma time uncertainty in seconds.

2.173 Umbrella2.Pipeline.ExtraIO.Resource Class Reference

Public Member Functions

- [Resource](#) (XElement ResourceElement)
- override string [ToString](#) ()

Public Attributes

- string [Name](#)
- List< [DataTable](#) > [Tables](#)

2.173.1 Constructor & Destructor Documentation

Resource()

```
Umbrella2.Pipeline.ExtraIO.Resource.Resource (
    XElement ResourceElement)
```

2.173.2 Member Function Documentation

ToString()

```
override string Umbrella2.Pipeline.ExtraIO.Resource.ToString ()
```

2.173.3 Member Data Documentation

Name

```
string Umbrella2.Pipeline.ExtraIO.Resource.Name
```

Tables

```
List<DataTable> Umbrella2.Pipeline.ExtraIO.Resource.Tables
```

2.174 Umbrella2.Algorithms.Images.RestrictedMean Class Reference

Class containing filtering algorithms that combine median filtering with averaging.

Static Public Member Functions

- static [SchedCore.AlgorithmRunParameters Parameters](#) (int PSFRadius)
Common algorithm parameters for [RestrictedMean](#) algorithms.
- static void [RestrictedMeanAlgorithm](#) (double[,] Input, double[,] Output, double[] PSF)
Computes a weighted mean using a subset of the data.

Properties

- static SchedCore.SimpleMap< double[] > [RestrictedMeanFilter](#) [get]
Filters the input using a restricted mean filter. The argument given is the PSF importance distribution.
- static SchedCore.SimpleMap< double[], ImageStatistics > [MultiMedianFilter](#) [get]
Filters the input using a median filter that also considers the closest neighbor pixel values.

Static Private Member Functions

- static void [MultiMedianAlgorithm](#) (double[,] Input, double[,] Output, double[] PSF, ImageStatistics imStat)
Computes the mean of median and first neighbors.

2.174.1 Detailed Description

Class containing filtering algorithms that combine median filtering with averaging.

2.174.2 Member Function Documentation

MultiMedianAlgorithm()

```
static void Umbrella2.Algorithms.Images.RestrictedMean.MultiMedianAlgorithm (
    double Input[,],
    double Output[,],
    double[] PSF,
    ImageStatistics imStat) [static], [private]
```

Computes the mean of median and first neighbors.

The PSF distribution is not the optical PSF, rather it is the distribution of the importance of pixel values around a point.

Parameters

<i>Input</i>	Input data.
<i>Output</i>	Output data.
<i>PSF</i>	Point spread function distribution.
<i>imStat</i>	Precomputed image information.

Parameters()

```
static SchedCore.AlgorithmRunParameters Umbrella2.Algorithms.Images.RestrictedMean.Parameters
(
    int PSFRadius) [static]
```

Common algorithm parameters for [RestrictedMean](#) algorithms.

Parameters

<i>PSFRadius</i>	Radius of the PSF importance distribution.
------------------	--

RestrictedMeanAlgorithm()

```
static void Umbrella2.Algorithms.Images.RestrictedMean.RestrictedMeanAlgorithm (
    double Input[,],
    double Output[,],
    double[] PSF) [static]
```

Computes a weighted mean using a subset of the data.

The PSF distribution is not the optical PSF, rather it is the distribution of the importance of pixel values around a point.

Parameters

<i>Input</i>	Input data.
<i>Output</i>	Output data.
<i>PSF</i>	Point spread function distribution.

2.174.3 Property Documentation

MultiMedianFilter

```
SchedCore.SimpleMap<double[], ImageStatistics> Umbrella2.Algorithms.Images.RestrictedMean.MultiMedianFilter [static], [get]
```

Filters the input using a median filter that also considers the closest neighbor pixel values.

RestrictedMeanFilter

```
SchedCore.SimpleMap<double[]> Umbrella2.Algorithms.Images.RestrictedMean.RestrictedMeanFilter [static], [get]
```

Filters the input using a restricted mean filter. The argument given is the PSF importance distribution.

2.175 Umbrella2.Algorithms.Images.RLHT Class Reference

Classes

- struct [AlgorithmData](#)
Bag of data containing runtime RLHT values.
- struct [HTResult](#)
Result of running a Hough Transform.
- struct [ImageParameters](#)
Bag of data containing thresholds and detection algorithm image-specific parameters.

Static Package Functions

- static [HTResult SmartSkipRLHT](#) (double[,] Input, [ImageParameters](#) ImP, [AlgorithmData](#) AGD)
Runs the RLHT over the image, skipping lines around uninteresting areas.

Static Private Member Functions

- static void [Lineover](#) (double[,] Input, int Height, int Width, double Rho, double Theta, [ImageParameters](#) DetectionParameters, out double HoughSum, out double LineLength)
Runs the Hough Transform over a line.
- static float [FAtanS](#) (float Tan)
Fast atan(-like) function with values scaled on 0.25-1.
- static float[] [FAtanGen](#) ()
Computes the.
- static void [SimpleLineover](#) (double[,] Input, int Height, int Width, double Rho, double Theta, [ImageParameters](#) DetectionParameters, out double HoughSum, out double LineLength, ref float[] LastVars, int LineSkip)
Runs the Hough Transform over a line.
- static float [FPow](#) (float Base, int Exponent)

Static Private Attributes

- const int `FAtanCount` = 50
Number of entries in approximation table.
- static float[] `FAtanValues` = `FAtanGen()`
The approximation table.

2.175.1 Member Function Documentation

FAtanGen()

```
static float[] Umbrella2.Algorithms.Images.RLHT.FAtanGen () [static], [private]
```

Computes the
`FAtanS`

tables.

Returns

A table of 32-bit floats that approximate the Atan function.

FAtanS()

```
static float Umbrella2.Algorithms.Images.RLHT.FAtanS (  
    float Tan) [static], [private]
```

Fast atan(-like) function with values scaled on 0.25-1.

Implementation is an approximation of $0.5 + \text{Atan}(\text{Tan}-1) / \text{PI}$.

FPow()

```
static float Umbrella2.Algorithms.Images.RLHT.FPow (  
    float Base,  
    int Exponent) [static], [private]
```

Lineover()

```
static void Umbrella2.Algorithms.Images.RLHT.Lineover (  
    double Input[,],  
    int Height,  
    int Width,  
    double Rho,  
    double Theta,  
    ImageParameters DetectionParameters,  
    out double HoughSum,  
    out double LineLength) [static], [private]
```

Runs the Hough Transform over a line.

Parameters

<i>Input</i>	Input image data.
<i>Height</i>	Image Height.
<i>Width</i>	Image Width.
<i>Rho</i>	Radial coordinate.
<i>Theta</i>	Angular coordinate.
<i>DetectionParameters</i>	Image-specific algorithm parameters.
<i>HoughSum</i>	Hough transform output for given coordinates.
<i>LineLength</i>	Length of the scanned line.

SimpleLineover()

```
static void Umbrella2.Algorithms.Images.RLHT.SimpleLineover (
    double Input[,],
    int Height,
    int Width,
    double Rho,
    double Theta,
    ImageParameters DetectionParameters,
    out double HoughSum,
    out double LineLength,
    ref float[] LastVars,
    int LineSkip) [static], [private]
```

Runs the Hough Transform over a line.

Parameters

<i>Input</i>	Input image data.
<i>Height</i>	Image Height.
<i>Width</i>	Image Width.
<i>Rho</i>	Radial coordinate.
<i>Theta</i>	Angular coordinate.
<i>DetectionParameters</i>	Image-specific algorithm parameters.
<i>HoughSum</i>	Hough transform output for given coordinates.
<i>LineLength</i>	Length of the scanned line.
<i>LastVars</i>	Data pool to be recycled between calls. Initialized internally.
<i>LineSkip</i>	Amount of pixels by which to skip when computing the line score.

SmartSkipRLHT()

```
static HTResult Umbrella2.Algorithms.Images.RLHT.SmartSkipRLHT (
    double Input[,],
    ImageParameters ImP,
    AlgorithmData AGD) [static], [package]
```

Runs the [RLHT](#) over the image, skipping lines around uninteresting areas.

Parameters

<i>Input</i>	Input image segment.
<i>ImP</i>	Image-specific detection parameters.
<i>AGD</i>	Algorithm arguments.

Returns

2.175.2 Member Data Documentation

FAtanCount

```
const int Umbrella2.Algorithms.Images.RLHT.FAtanCount = 50 [static], [private]
```

Number of entries in approximation table.

FAtanValues

```
float [] Umbrella2.Algorithms.Images.RLHT.FAtanValues = FAtanGen() [static], [private]
```

The approximation table.

2.176 Umbrella2.Algorithms.Images.SchedCore.RunDetails Struct Reference

Bag of data for the algorithm run.

Public Attributes

- System.Delegate [Algorithm](#)
Function to be run.
- object[] [Parameters](#)
Arguments passed through from the caller.
- [AlgorithmType](#) Type
Delegate type.
- [Image\[\] InputImages](#)
Images read by the scheduler and fed into the target algorithm.
- [Image OutputImage](#)
Image to be written by the algorithm.
- int [InputMargins](#)
Same as [AlgorithmRunParameters.InputMargins](#).
- int [Ystep](#)
Same as [AlgorithmRunParameters.Ystep](#).
- int [Xstep](#)
Same as [AlgorithmRunParameters.Xstep](#).
- int [DataWidth](#)
Width of the working image.
- int [DataHeight](#)
Height of the working image.
- bool [FillZero](#)
Same as [AlgorithmRunParameters.FillZero](#).

2.176.1 Detailed Description

Bag of data for the algorithm run.

2.176.2 Member Data Documentation

Algorithm

```
System.Delegate Umbrella2.Algorithms.Images.SchedCore.RunDetails.Algorithm
```

Function to be run.

DataHeight

```
int Umbrella2.Algorithms.Images.SchedCore.RunDetails.DataHeight
```

Height of the working image.

DataWidth

```
int Umbrella2.Algorithms.Images.SchedCore.RunDetails.DataWidth
```

Width of the working image.

FillZero

```
bool Umbrella2.Algorithms.Images.SchedCore.RunDetails.FillZero
```

Same as [AlgorithmRunParameters.FillZero](#).

InputImages

```
Image [] Umbrella2.Algorithms.Images.SchedCore.RunDetails.InputImages
```

[Images](#) read by the scheduler and fed into the target algorithm.

InputMargins

```
int Umbrella2.Algorithms.Images.SchedCore.RunDetails.InputMargins
```

Same as [AlgorithmRunParameters.InputMargins](#).

OutputImage

```
Image Umbrella2.Algorithms.Images.SchedCore.RunDetails.OutputImage
```

Image to be written by the algorithm.

Parameters

```
object [] Umbrella2.Algorithms.Images.SchedCore.RunDetails.Parameters
```

Arguments passed through from the caller.

Type

```
AlgorithmType Umbrella2.Algorithms.Images.SchedCore.RunDetails.Type
```

Delegate type.

Xstep

```
int Umbrella2.Algorithms.Images.SchedCore.RunDetails.Xstep
```

Same as [AlgorithmRunParameters.Xstep](#).

Ystep

```
int Umbrella2.Algorithms.Images.SchedCore.RunDetails.Ystep
```

Same as [AlgorithmRunParameters.Ystep](#).

2.177 Umbrella2.Algorithms.Schedulers.RunDetails Struct Reference

Bag of data for the algorithm run.

Public Attributes

- System.Delegate [Algorithm](#)
Function to be run.
- object[] [Parameters](#)
Arguments passed through from the caller.
- AlgorithmType [Type](#)
Delegate type.
- Image[] [InputImages](#)
Images read by the scheduler and fed into the target algorithm.
- Image [OutputImage](#)
Image to be written by the algorithm.
- int [InputMargins](#)
Same as [AlgorithmRunParameters.InputMargins](#).
- int [Ystep](#)
Same as [AlgorithmRunParameters.Ystep](#).
- int [Xstep](#)
Same as [AlgorithmRunParameters.Xstep](#).
- int [DataWidth](#)
Width of the working image.
- int [DataHeight](#)
Height of the working image.
- bool [FillZero](#)
Same as [AlgorithmRunParameters.FillZero](#).

2.177.1 Detailed Description

Bag of data for the algorithm run.

2.177.2 Member Data Documentation

Algorithm

```
System.Delegate Umbrella2.Algorithms.Schedulers.RunDetails.Algorithm
```

Function to be run.

DataHeight

```
int Umbrella2.Algorithms.Schedulers.RunDetails.DataHeight
```

Height of the working image.

DataWidth

```
int Umbrella2.Algorithms.Schedulers.RunDetails.DataWidth
```

Width of the working image.

FillZero

```
bool Umbrella2.Algorithms.Schedulers.RunDetails.FillZero
```

Same as [AlgorithmRunParameters.FillZero](#).

InputImages

```
Image [] Umbrella2.Algorithms.Schedulers.RunDetails.InputImages
```

[Images](#) read by the scheduler and fed into the target algorithm.

InputMargins

```
int Umbrella2.Algorithms.Schedulers.RunDetails.InputMargins
```

Same as [AlgorithmRunParameters.InputMargins](#).

OutputImage

```
Image Umbrella2.Algorithms.Schedulers.RunDetails.OutputImage
```

Image to be written by the algorithm.

Parameters

```
object [] Umbrella2.Algorithms.Schedulers.RunDetails.Parameters
```

Arguments passed through from the caller.

Type

```
AlgorithmType Umbrella2.Algorithms.Schedulers.RunDetails.Type
```

Delegate type.

Xstep

```
int Umbrella2.Algorithms.Schedulers.RunDetails.Xstep
```

Same as [AlgorithmRunParameters.Xstep](#).

Ystep

```
int Umbrella2.Algorithms.Schedulers.RunDetails.Ystep
```

Same as [AlgorithmRunParameters.Ystep](#).

2.178 Umbrella2.Framework.RWLockArea Class Reference

Provides readers-writers lock for images.

Public Member Functions

- [RWLockArea](#) ()
- Guid [EnterLock](#) (Rectangle zone, bool WriteLock)
Acquire a read or write lock.
- void [ExitLock](#) (Guid Lock)
Exits an acquired lock.
- void [ForceExitLock](#) (Guid Lock)
Force exits locks held by other threads.

Private Member Functions

- void [ExitLock](#) (Guid Lock, bool Force)

Private Attributes

- List< Tuple< Rectangle, bool, Thread, Guid > > [Areas](#)
List of areas locked. Should usually be small enough to be kept in a list (rather than some other more complex data structure). Tuple order: Area, Writer lock, Locking thread, Locking token.
- ManualResetEvent [WaitingMechanism](#)

2.178.1 Detailed Description

Provides readers-writers lock for images.

2.178.2 Constructor & Destructor Documentation

RWLockArea()

```
Umbrella2.Framework.RWLockArea.RWLockArea ()
```

2.178.3 Member Function Documentation

EnterLock()

```
Guid Umbrella2.Framework.RWLockArea.EnterLock (  
    Rectangle zone,  
    bool WriteLock)
```

Acquire a read or write lock.

Parameters

<i>zone</i>	Image area over which to get the lock.
<i>WriteLock</i>	True if the lock is a writer lock, false if it is a reader lock.

Returns

A lock token.

ExitLock() [1/2]

```
void Umbrella2.Framework.RWLockArea.ExitLock (  
    Guid Lock)
```

Exits an acquired lock.

Parameters

<i>Lock</i>	The lock token.
-------------	-----------------

ExitLock() [2/2]

```
void Umbrella2.Framework.RWLockArea.ExitLock (  
    Guid Lock,  
    bool Force) [private]
```

ForceExitLock()

```
void Umbrella2.Framework.RWLockArea.ForceExitLock (  
    Guid Lock)
```

Force exits locks held by other threads.

Parameters

<i>Lock</i>	The lock token.
-------------	-----------------

2.178.4 Member Data Documentation

Areas

```
List<Tuple<Rectangle, bool, Thread, Guid> > Umbrella2.Framework.RWLockArea.Areas [private]
```

List of areas locked. Should usually be small enough to be kept in a list (rather than some other more complex data structure). Tuple order: Area, Writer lock, Locking thread, Locking token.

Thread safety in reading internal lock state is obtained by locking this list.

WaitingMechanism

```
ManualResetEvent Umbrella2.Framework.RWLockArea.WaitingMechanism [private]
```

2.179 Umbrella2.Algorithms.Images.SchedCore Class Reference

Algorithm scheduling core interface.

Classes

- struct [AlgorithmRunParameters](#)
Common algorithm parameters. Usually specified by algorithm type.
- struct [ImageSegmentPosition](#)
Represents the position of a block of data w.r.t. the image.
- struct [RunDetails](#)
Bag of data for the algorithm run.

Public Types

- enum [AlgorithmType](#) {
[SimpleMap_T](#) , [SimpleMap_TU](#) , [SimpleMap_TUV](#) , [PositionMap](#) ,
[Combiner](#) , [Extractor](#) , [PositionExtractor](#) }
Which delegate the algorithm corresponds to.

Public Member Functions

- delegate void [SimpleMap< T >](#) (double[,] Input, double[,] Output, T Extra)
Delegate for a transform that maps one input image to an output image with one extra argument.
- delegate void [SimpleMap< T, U >](#) (double[,] Input, double[,] Output, T Extra1, U Extra2)
Delegate for a transform that maps one input image to an output image with two extra arguments.
- delegate void [SimpleMap< T, U, V >](#) (double[,] Input, double[,] Output, T Extra1, U Extra2, V Extra3)
Delegate for a transform that maps one input image to an output image with three extra arguments.
- delegate void [PositionDependentMap< T >](#) (double[,] Input, double[,] Output, [ImageSegmentPosition](#) InputPosition, [ImageSegmentPosition](#) OutputPosition, T Extra)
Delegate for a transform that maps one input image to an output image using pixel position information.
- delegate void [Combiner< T >](#) (double[,] Inputs, double[,] Output, [ImageSegmentPosition](#)[] InputPositions, [ImageSegmentPosition](#) OutputPosition, T Extra)
Delegate for a transform that maps multiple input images to an output image with one extra argument.
- delegate void [Extractor< T >](#) (double[,] Input, T Extra)
Delegate for a transform that reads data from an input image with one extra argument.
- delegate void [PositionDependentExtractor< T >](#) (double[,] Input, [ImageSegmentPosition](#) InputPosition, T Extra)
Delegate for a transform that reads data from an input image with one extra argument.
- delegate void [Scheduler](#) ([RunDetails](#) RunParameters)
Represents a scheduler for image processing functions. It must run the functions of a given algorithm over the image, according to the given parameters.

Static Public Member Functions

- static void [RunAlgorithm< T >](#) ([Extractor< T >](#) Algorithm, T Argument, [Image](#) Input, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [RunAlgorithm< T >](#) ([PositionDependentExtractor< T >](#) Algorithm, T Argument, [Image](#) Input, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [RunAlgorithm< T >](#) ([SimpleMap< T >](#) Algorithm, T Argument, [Image](#) Input, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [RunAlgorithm< T, U >](#) ([SimpleMap< T, U >](#) Algorithm, T Argument1, U Argument2, [Image](#) Input, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [RunAlgorithm< T, U, V >](#) ([SimpleMap< T, U, V >](#) Algorithm, T Argument1, U Argument2, V Argument3, [Image](#) Input, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [RunAlgorithm< T >](#) ([PositionDependentMap< T >](#) Algorithm, T Argument, [Image](#) Input, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [RunAlgorithm< T >](#) ([Combiner< T >](#) Algorithm, T Argument, [Image](#)[] Inputs, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)
Runs the given algorithm on the input data.
- static void [Run< T >](#) (this [SimpleMap< T >](#) Algorithm, T Argument, [Image](#) Input, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)
- static void [Run< T, U >](#) (this [SimpleMap< T, U >](#) Algorithm, T Argument1, U Argument2, [Image](#) Input, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)
- static void [Run< T, U, V >](#) (this [SimpleMap< T, U, V >](#) Algorithm, T Argument1, U Argument2, V Argument3, [Image](#) Input, [Image](#) Output, [AlgorithmRunParameters](#) Parameters)

- static void `Run< T >` (this `PositionDependentMap< T >` Algorithm, T Argument, `Image` Input, `Image` Output, `AlgorithmRunParameters` Parameters)
- static void `Run< T >` (this `Combiner< T >` Algorithm, T Argument, `Image[]` Input, `Image` Output, `AlgorithmRunParameters` Parameters)
- static void `Run< T >` (this `Extractor< T >` Algorithm, T Argument, `Image` Input, `AlgorithmRunParameters` Parameters)
- static void `Run< T >` (this `PositionDependentExtractor< T >` Algorithm, T Argument, `Image` Input, `AlgorithmRunParameters` Parameters)

Static Public Attributes

- static bool `ForceSerial` = false
Force the code to run single-threaded.
- static `Scheduler DefaultScheduler` = `Schedulers.CPUParallel.Scheduler`
The scheduler used when calling `RunAlgorithm` or `Run` on a the delegate of the algorithm.

Static Package Functions

- static void `PrepareGeometry` (ref `RunDetails` Details, `AlgorithmRunParameters` Parameters)
Prepares algorithm geometry.

2.179.1 Detailed Description

Algorithm scheduling core interface.

2.179.2 Member Enumeration Documentation

AlgorithmType

enum `Umbrella2.Algorithms.Images.SchedCore.AlgorithmType`

Which delegate the algorithm corresponds to.

Enumerator

SimpleMap_T	
SimpleMap_TU	
SimpleMap_TUV	
PositionMap	
Combiner	
Extractor	
PositionExtractor	

2.179.3 Member Function Documentation

Combiner< T >()

```
delegate void Umbrella2.Algorithms.Images.SchedCore.Combiner< T > (
    double Inputs[][,],
    double Output[,],
    ImageSegmentPosition[] InputPositions,
    ImageSegmentPosition OutputPosition,
    T Extra)
```

Delegate for a transform that maps multiple input images to an output image with one extra argument.

Template Parameters

<i>T</i>	Type of the extra argument.
----------	-----------------------------

Parameters

<i>Inputs</i>	Input images data.
<i>Output</i>	Output image data.
<i>InputPositions</i>	Positions of the input data w.r.t. the input images.
<i>OutputPosition</i>	Position of the output data w.r.t. the output image.
<i>Extra</i>	Passed-through argument.

Extractor< T >()

```
delegate void Umbrella2.Algorithms.Images.SchedCore.Extractor< T > (
    double Input[,],
    T Extra)
```

Delegate for a transform that reads data from an input image with one extra argument.

The extra argument typically collects the results.

Template Parameters

<i>T</i>	Type of the extra argument.
----------	-----------------------------

Parameters

<i>Input</i>	Input image data.
<i>Extra</i>	Passed-through argument.

PositionDependentExtractor< T >()

```
delegate void Umbrella2.Algorithms.Images.SchedCore.PositionDependentExtractor< T > (
    double Input[,],
    ImageSegmentPosition InputPosition,
    T Extra)
```

Delegate for a transform that reads data from an input image with one extra argument.

The extra argument typically collects the results.

Template Parameters

<i>T</i>	Type of the extra argument.
----------	-----------------------------

Parameters

<i>Input</i>	Input image data.
<i>InputPosition</i>	Position of the input data w.r.t. the input image.
<i>Extra</i>	Passed-through argument.

PositionDependentMap< T >()

```
delegate void Umbrella2.Algorithms.Images.SchedCore.PositionDependentMap< T > (
    double Input[,],
    double Output[,],
    ImageSegmentPosition InputPosition,
    ImageSegmentPosition OutputPosition,
    T Extra)
```

Delegate for a transform that maps one input image to an output image using pixel position information.

Template Parameters

<i>T</i>	Type of the extra argument.
----------	-----------------------------

Parameters

<i>Input</i>	Input image data.
<i>Output</i>	Output image data.
<i>InputPosition</i>	Position of the input data w.r.t. the input image.
<i>OutputPosition</i>	Position of the output data w.r.t. the output image.
<i>Extra</i>	

PrepareGeometry()

```
static void Umbrella2.Algorithms.Images.SchedCore.PrepareGeometry (
    ref RunDetails Details,
    AlgorithmRunParameters Parameters) [static], [package]
```

Prepares algorithm geometry.

Parameters

<i>Details</i>	Parameters to prepare.
<i>Parameters</i>	Input parameters.

Run< T >() [1/5]

```
static void Umbrella2.Algorithms.Images.SchedCore.Run< T > (
    this Combiner< T > Algorithm,
    T Argument,
    Image[] Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Run< T >() [2/5]

```
static void Umbrella2.Algorithms.Images.SchedCore.Run< T > (
    this Extractor< T > Algorithm,
    T Argument,
    Image Input,
    AlgorithmRunParameters Parameters) [static]
```

Run< T >() [3/5]

```
static void Umbrella2.Algorithms.Images.SchedCore.Run< T > (
    this PositionDependentExtractor< T > Algorithm,
    T Argument,
    Image Input,
    AlgorithmRunParameters Parameters) [static]
```

Run< T >() [4/5]

```
static void Umbrella2.Algorithms.Images.SchedCore.Run< T > (
    this PositionDependentMap< T > Algorithm,
    T Argument,
    Image Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Run< T >() [5/5]

```
static void Umbrella2.Algorithms.Images.SchedCore.Run< T > (
    this SimpleMap< T > Algorithm,
    T Argument,
    Image Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Run< T, U >()

```
static void Umbrella2.Algorithms.Images.SchedCore.Run< T, U > (
    this SimpleMap< T, U > Algorithm,
    T Argument1,
    U Argument2,
    Image Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Run< T, U, V >()

```
static void Umbrella2.Algorithms.Images.SchedCore.Run< T, U, V > (
    this SimpleMap< T, U, V > Algorithm,
    T Argument1,
    U Argument2,
    V Argument3,
    Image Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

RunAlgorithm< T >() [1/5]

```
static void Umbrella2.Algorithms.Images.SchedCore.RunAlgorithm< T > (
    Combiner< T > Algorithm,
    T Argument,
    Image[] Inputs,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	Extra parameter type.
----------	-----------------------

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument</i>	Argument to be passed to all invocations.
<i>Inputs</i>	Input images.
<i>Output</i>	Output image.
<i>Parameters</i>	Parameters of the algorithm run.

RunAlgorithm< T >() [2/5]

```
static void Umbrella2.Algorithms.Images.SchedCore.RunAlgorithm< T > (
    Extractor< T > Algorithm,
    T Argument,
    Image Input,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	Extra parameter type.
----------	-----------------------

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument</i>	Argument to be passed to all invocations.
<i>Input</i>	Input image.
<i>Parameters</i>	Parameters of the algorithm run.

RunAlgorithm< T >() [3/5]

```
static void Umbrella2.Algorithms.Images.SchedCore.RunAlgorithm< T > (
    PositionDependentExtractor< T > Algorithm,
    T Argument,
    Image Input,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	Extra parameter type.
----------	-----------------------

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument</i>	Argument to be passed to all invocations.
<i>Input</i>	Input image.
<i>Parameters</i>	Parameters of the algorithm run.

RunAlgorithm< T >() [4/5]

```
static void Umbrella2.Algorithms.Images.SchedCore.RunAlgorithm< T > (
    PositionDependentMap< T > Algorithm,
    T Argument,
    Image Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	Extra parameter type.
----------	-----------------------

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument</i>	Argument to be passed to all invocations.
<i>Input</i>	Input image.
<i>Output</i>	Output image.
<i>Parameters</i>	Parameters of the algorithm run.

RunAlgorithm< T >() [5/5]

```
static void Umbrella2.Algorithms.Images.SchedCore.RunAlgorithm< T > (
    SimpleMap< T > Algorithm,
    T Argument,
    Image Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	Extra parameter type.
----------	-----------------------

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument</i>	Argument to be passed to all invocations.
<i>Input</i>	Input image.
<i>Output</i>	Output image.
<i>Parameters</i>	Parameters of the algorithm run.

RunAlgorithm< T, U >()

```
static void Umbrella2.Algorithms.Images.SchedCore.RunAlgorithm< T, U > (
    SimpleMap< T, U > Algorithm,
    T Argument1,
    U Argument2,
    Image Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	First extra parameter type.
<i>U</i>	Second extra parameter type.

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument1</i>	First argument to be passed to all invocations.
<i>Argument2</i>	Second argument to be passed to all invocations.
<i>Input</i>	Input image.
<i>Output</i>	Output image.
<i>Parameters</i>	Parameters of the algorithm run.

RunAlgorithm< T, U, V >()

```
static void Umbrella2.Algorithms.Images.SchedCore.RunAlgorithm< T, U, V > (
    SimpleMap< T, U, V > Algorithm,
    T Argument1,
    U Argument2,
    V Argument3,
    Image Input,
    Image Output,
    AlgorithmRunParameters Parameters) [static]
```

Runs the given algorithm on the input data.

Template Parameters

<i>T</i>	First extra parameter type.
<i>U</i>	Second extra parameter type.
<i>V</i>	Third extra parameter type.

Parameters

<i>Algorithm</i>	Parallel algorithm.
<i>Argument1</i>	First argument to be passed to all invocations.
<i>Argument2</i>	Second argument to be passed to all invocations.
<i>Argument3</i>	Third argument to be passed to all invocations.
<i>Input</i>	Input image.
<i>Output</i>	Output image.
<i>Parameters</i>	Parameters of the algorithm run.

Scheduler()

```
delegate void Umbrella2.Algorithms.Images.SchedCore.Scheduler (
    RunDetails RunParameters)
```

Represents a scheduler for image processing functions. It must run the functions of a given algorithm over the image, according to the given parameters.

Parameters

<i>RunParameters</i>	Parameters that specify the context to be prepared for the called function.
----------------------	---

SimpleMap< T >()

```
delegate void Umbrella2.Algorithms.Images.SchedCore.SimpleMap< T > (
    double Input[,],
    double Output[,],
    T Extra)
```

Delegate for a transform that maps one input image to an output image with one extra argument.

Template Parameters

<i>T</i>	Type of the argument passed.
----------	------------------------------

Parameters

<i>Input</i>	Input image data.
<i>Output</i>	Output image data.
<i>Extra</i>	Passed-through argument.

SimpleMap< T, U >()

```
delegate void Umbrella2.Algorithms.Images.SchedCore.SimpleMap< T, U > (
    double Input[],
    double Output[],
    T Extra1,
    U Extra2)
```

Delegate for a transform that maps one input image to an output image with two extra arguments.

Template Parameters

<i>T</i>	Type of the first argument passed.
<i>U</i>	Type of the second argument passed.

Parameters

<i>Input</i>	Input image data.
<i>Output</i>	Output image data.
<i>Extra1</i>	First passed-through argument.
<i>Extra2</i>	Second passed-through argument.

SimpleMap< T, U, V >()

```
delegate void Umbrella2.Algorithms.Images.SchedCore.SimpleMap< T, U, V > (
    double Input[],
    double Output[],
    T Extra1,
    U Extra2,
    V Extra3)
```

Delegate for a transform that maps one input image to an output image with three extra arguments.

Template Parameters

<i>T</i>	Type of the first argument passed.
<i>U</i>	Type of the second argument passed.
<i>V</i>	Type of the third argument passed.

Parameters

<i>Input</i>	Input image data.
<i>Output</i>	Output image data.
<i>Extra1</i>	First passed-through argument.
<i>Extra2</i>	Second passed-through argument.
<i>Extra3</i>	>Third passed-through argument.

2.179.4 Member Data Documentation

DefaultScheduler

`Scheduler` Umbrella2.Algorithms.Images.SchedCore.DefaultScheduler = `Schedulers.CPUParallel.Scheduler` [static]

The scheduler used when calling RunAlgorithm or Run on a the delegate of the algorithm.

ForceSerial

`bool` Umbrella2.Algorithms.Images.SchedCore.ForceSerial = `false` [static]

Force the code to run single-threaded.

2.180 Umbrella2.Algorithms.Images.Schedulers.SchedUtil Class Reference

Useful functions for implementing schedulers.

Classes

- struct `ThreadDetails`
Thread-specific parameter bag. Can be used for implementing threaded schedulers.

Static Public Member Functions

- static void `ReadImageBlock` (RunDetails RD, `Image` Selected, ref `ImageData` Data, ref `ThreadDetails` TD)
Reads a block of data from the input images.
- static void `ProcessOutput` (RunDetails RunDetails, `ThreadDetails` ThDetails, ref `ImageData` OutputData)
Initializes and writes data to output image.
- static `ImageSegmentPosition` `GetPosition` (`ImageData` Data)
Computes an ImageSegmentPosition from an ImageData.

Static Private Member Functions

- static void `LockDataNoFill` (RunDetails RD, `ThreadDetails` TD, `Image` Image, ref `ImageData` Data, bool Read-only)

2.180.1 Detailed Description

Useful functions for implementing schedulers.

2.180.2 Member Function Documentation

GetPosition()

```
static ImageSegmentPosition Umbrella2.Algorithms.Images.Schedulers.SchedUtil.GetPosition (  
    ImageData Data) [static]
```

Computes an ImageSegmentPosition from an ImageData.

LockDataNoFill()

```
static void Umbrella2.Algorithms.Images.Schedulers.SchedUtil.LockDataNoFill (  
    RunDetails RD,  
    ThreadDetails TD,  
    Image Image,  
    ref ImageData Data,  
    bool Readonly) [static], [private]
```

ProcessOutput()

```
static void Umbrella2.Algorithms.Images.Schedulers.SchedUtil.ProcessOutput (  
    RunDetails RunDetails,  
    ThreadDetails ThDetails,  
    ref ImageData OutputData) [static]
```

Initializes and writes data to output image.

ReadImageBlock()

```
static void Umbrella2.Algorithms.Images.Schedulers.SchedUtil.ReadImageBlock (  
    RunDetails RD,  
    Image Selected,  
    ref ImageData Data,  
    ref ThreadDetails TD) [static]
```

Reads a block of data from the input images.

2.181 Umbrella2.Visualizer.WinForms.PropertyViewer.ShownDocumentation Struct Reference

XML strings for the given documented element.

Public Attributes

- string [SummaryXML](#)
- string [RemarksXML](#)

2.181.1 Detailed Description

XML strings for the given documented element.

2.181.2 Member Data Documentation

RemarksXML

```
string Umbrella2.Visualizer.WinForms.PropertyViewer.ShownDocumentation.RemarksXML
```

SummaryXML

```
string Umbrella2.Visualizer.WinForms.PropertyViewer.ShownDocumentation.SummaryXML
```

2.182 Umbrella2.Algorithms.Images.Median.SkippedMedian Class Reference

Static Public Member Functions

- static void [EstimatorFRMedian](#) (double[,] Input, double[,] Output, double[] PSF)
Computes the weighted median of the input.

Properties

- static double [AvgQselCount](#) [get]

Static Private Attributes

- static double [SDCountD](#) = 0.35
Amount of standard deviations to include downwards.
- static double [SDCountU](#) = 0.3
Amount of standard deviations to include upwards.
- static double [IndistinguishableWeight](#) = Math.Pow(10, -6)
Weight threshold for the eventual float rounding mismatches.
- static long [AvCount](#) = 0
Number of input pixels passing through to quickselect.
- static long [AvRun](#) = 0
Number of output pixels processed.
- static long [CPred](#) = 0
Number of median prediction hits.
- static int [Skip](#) = 4

2.182.1 Member Function Documentation

EstimatorFRMedian()

```
static void Umbrella2.Algorithms.Images.Median.SkippedMedian.EstimatorFRMedian (
    double Input[,],
    double Output[,],
    double[] PSF) [static]
```

Computes the weighted median of the input.

Parameters

<i>Input</i>	Input data.
<i>Output</i>	Output data.
<i>PSF</i>	PSF importance distribution / median weights.

2.182.2 Member Data Documentation**AvCount**

```
long Umbrella2.Algorithms.Images.Median.SkippedMedian.AvCount = 0 [static], [private]
```

Number of input pixels passing through to quickselect.

AvRun

```
long Umbrella2.Algorithms.Images.Median.SkippedMedian.AvRun = 0 [static], [private]
```

Number of output pixels processed.

CPred

```
long Umbrella2.Algorithms.Images.Median.SkippedMedian.CPred = 0 [static], [private]
```

Number of median prediction hits.

IndistinguishableWeight

```
double Umbrella2.Algorithms.Images.Median.SkippedMedian.IndistinguishableWeight = Math.Pow(10, -6) [static], [private]
```

Weight threshold for the eventual float rounding mismatches.

SDCountD

```
double Umbrella2.Algorithms.Images.Median.SkippedMedian.SDCountD = 0.35 [static], [private]
```

Amount of standard deviations to include downwards.

SDCountU

```
double Umbrella2.Algorithms.Images.Median.SkippedMedian.SDCountU = 0.3 [static], [private]
```

Amount of standard deviations to include upwards.

Skip

```
int Umbrella2.Algorithms.Images.Median.SkippedMedian.Skip = 4 [static], [private]
```

2.182.3 Property Documentation

AvgQselCount

```
double Umbrella2.Algorithms.Images.Median.SkippedMedian.AvgQselCount [static], [get], [private]
```

2.183 Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData Class Reference

SkyBoT pairing data for a given image.

Public Member Functions

- [SkyBotImageData](#) ([Image Image](#))
Creates the property.
- bool [RetrieveObjects](#) (string ObservatoryCode=null)
Performs the retrieval of objects.
- void [TryPair](#) ([Tracklet t](#), double Separation)
Tries pairing a tracklet (if it contains a detection in the time range of the image).
- List< [SkybotObject](#) > [GetUnpaired](#) ()
Fetch objects that should be in the image but have not been detected.
- override List< [MetadataRecord](#) > [GetRecords](#) ()

Public Member Functions inherited from [Umbrella2.IO.ImageProperties](#)

- [ImageProperties](#) ([Image Image](#))
Creates a new instance of the image properties for the given image.
- List< [MetadataRecord](#) > [GetRecords](#) ()
Gets the list of metadata records associated with the property.

Private Attributes

- readonly DateTime [ShotTime](#)
Time at which the data is valid.
- readonly TimeSpan [Exposure](#)
Interval for which the data is valid.
- [QuadTree](#)< [SkybotObject](#) > [ObjTree](#)
Object search structure.
- [SkybotObject](#)[] [ObjList](#)
SkyBoT results.
- HashSet< [SkybotObject](#) > [Unpaired](#)
Which objects have not been paired yet.
- readonly [EquatorialPoint](#) [ImageCenter](#)
The center of the image.
- readonly double [Radius](#)
Image radius.
- readonly [Image](#) [AssociatedImage](#)
Image associated to this property.

2.183.1 Detailed Description

SkyBoT pairing data for a given image.

2.183.2 Constructor & Destructor Documentation

SkyBotImageData()

```
Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.SkyBotImageData (
    Image Image)
```

Creates the property.

2.183.3 Member Function Documentation

GetRecords()

```
override List< MetadataRecord > Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.GetRecords ()
```

GetUnpaired()

```
List< SkybotObject > Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.GetUnpaired ()
```

Fetch objects that should be in the image but have not been detected.

Returns

The SkyBoT objects not found among the tracklets so far.

RetrieveObjects()

```
bool Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.RetrieveObjects (
    string ObservatoryCode = null)
```

Performs the retrieval of objects.

Returns

If the objects were retrieved successfully, `true`. If errors occurred, `false`.

Parameters

<i>ObservatoryCode</i>	Observatory code. If null, uses the SCS interface, without it.
------------------------	--

TryPair()

```
void Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.TryPair (
    Tracklet t,
    double Separation)
```

Tries pairing a tracklet (if it contains a detection in the time range of the image).

Parameters

<i>t</i>	Tracklet .
<i>Separation</i>	Maximum distance to consider, in arcseconds.

2.183.4 Member Data Documentation

AssociatedImage

```
readonly Image Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.AssociatedImage [private]
```

Image associated to this property.

Exposure

```
readonly TimeSpan Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.Exposure [private]
```

Interval for which the data is valid.

ImageCenter

```
readonly EquatorialPoint Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.ImageCenter [private]
```

The center of the image.

ObjList

```
SkybotObject [] Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.ObjList [private]
```

SkyBoT results.

ObjTree

```
QuadTree<SkybotObject> Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.ObjTree [private]
```

Object search structure.

Radius

```
readonly double Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.Radius [private]
```

Image radius.

ShotTime

```
readonly DateTime Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.ShotTime [private]
```

Time at which the data is valid.

Unpaired

```
HashSet<SkybotObject> Umbrella2.Pipeline.EIOAlgorithms.SkyBotImageData.Unpaired [private]
```

Which objects have not been paired yet.

2.184 Umbrella2.Pipeline.ExtraIO.SkyBoTLookup Class Reference

Provides an API for accessing the SkyBot services.

Classes

- struct [SkybotObject](#)
Represents an object returned by SkyBoT.

Static Public Member Functions

- static string [GenerateSCSUrl](#) ([EquatorialPoint](#) Location, double Radius, DateTime Time)
Generates an URL for the Simple Cone Search interface, to be used with [GetObjects\(string, DateTime, out List<SkybotObject>\)](#).
- static string [GenerateNSUrl](#) ([EquatorialPoint](#) Location, double Radius, DateTime Time, string ObsCode)
Generates an URL for the non-standard interface to SkyBoT.
- static bool [GetObjects](#) (string Url, DateTime Time, out List< [SkybotObject](#) > Objects)
Retrieves the list of objects from the given url.
- static List< [SkybotObject](#) > [GetObjects](#) ([EquatorialPoint](#) Location, double Radius, DateTime Time)
Retrieves a list of objects around a given location.

Static Private Attributes

- const string [SkybotURL](#) = "http://vo.imcce.fr/webservices/skybot/skybotconesearch_query.php?EPOCH="
- const string [NSInterface](#) = "http://vo.imcce.fr/webservices/skybot/skybotconesearch_query.php?"
- const string [NSParameters](#) = "-ep={0}&-ra={1}&-dec={2}&-rd={3}&-mime=votable&-output=basic&-loc={4}"
- const string [VOTxmlns](#) = "http://www.ivoa.net/xml/VOTable/v1.3"

2.184.1 Detailed Description

Provides an API for accessing the SkyBot services.

2.184.2 Member Function Documentation

GenerateNSUrl()

```
static string Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.GenerateNSUrl (
    EquatorialPoint Location,
    double Radius,
    DateTime Time,
    string ObsCode) [static]
```

Generates an URL for the non-standard interface to SkyBoT.

Returns

The URL to be used with [GetObjects\(string, DateTime, out List<SkybotObject>\)](#).

Parameters

<i>Location</i>	Location around which to search.
<i>Radius</i>	Search radius.
<i>Time</i>	The time at which to search for objects.
<i>ObsCode</i>	Observatory code.

GenerateSCSUrl()

```
static string Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.GenerateSCSUrl (
    EquatorialPoint Location,
    double Radius,
    DateTime Time) [static]
```

Generates an URL for the Simple Cone Search interface, to be used with [GetObjects\(string, DateTime, out List<SkybotObject>\)](#).

Returns

The URL to be used with [GetObjects\(string, DateTime, out List<SkybotObject>\)](#).

Parameters

<i>Location</i>	Location around which to search.
<i>Radius</i>	Search radius.
<i>Time</i>	The time at which to search for objects.

GetObjects() [1/2]

```
static List< SkybotObject > Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.GetObjects (
    EquatorialPoint Location,
    double Radius,
    DateTime Time) [static]
```

Retrieves a list of objects around a given location.

Parameters

<i>Location</i>	Location around which to search.
<i>Radius</i>	Radius of the search (in radians).
<i>Time</i>	The time at which to search for objects.

Returns

The list of objects.

GetObjects() [2/2]

```
static bool Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.GetObjects (
    string Url,
    DateTime Time,
    out List< SkybotObject > Objects) [static]
```

Retrieves the list of objects from the given url.

If the function returned false, but the object list is non-null, then required fields in the VOTable were missing.

Returns

true, if succeeded in obtaining, false otherwise.

Parameters

<i>Url</i>	The URL from which to retrieve objects.
<i>Time</i>	Time corresponding to the given URL.
<i>Objects</i>	The resulting list of objects.

2.184.3 Member Data Documentation**NSInterface**

```
const string Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.NSInterface = "http://vo.imcce.fr/webservices/skybot/skybot/_query.php?" [static], [private]
```

NSParameters

```
const string Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.NSParameters = "-ep={0}&-ra={1}&-dec={2}&-rd={3}&-mime=vo" [static], [private]
```

SkybotURL

```
const string Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.SkybotURL = "http://vo.imcce.fr/webservices/skybot/skybot/_query.php?EPOCH=" [static], [private]
```

VOTxmlns

```
const string Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.VOTxmlns = "http://www.ivoa.net/xml/VOTable/v1.↵  
3" [static], [private]
```

2.185 Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.SkybotObject Struct Reference

Represents an object returned by SkyBoT.

Public Member Functions

- [SkybotObject](#) (string [Name](#), string [Position](#), DateTime [Time](#), int? [PermDesignation](#), string [Class](#), double [magV](#), double [ErrPos](#))

Public Attributes

- readonly string [Name](#)
Name of the object.
- readonly [EquatorialPoint](#) [Position](#)
Position of the object.
- readonly DateTime [TimeCoordinate](#)
Time at which the object is at the specified position.
- readonly? int [PermanentDesignation](#)
The object's permanent designation.
- readonly string [Class](#)
The object's asteroid class.
- readonly double [VisualMagnitude](#)
The object's visual magnitude.
- readonly double [PositionUncertainty](#)
The object's position uncertainty.

2.185.1 Detailed Description

Represents an object returned by SkyBoT.

2.185.2 Constructor & Destructor Documentation

SkybotObject()

```
Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.SkybotObject.SkybotObject (  
    string Name,  
    string Position,  
    DateTime Time,  
    int? PermDesignation,  
    string Class,  
    double magV,  
    double ErrPos)
```

2.185.3 Member Data Documentation

Class

```
readonly string Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.SkybotObject.Class
```

The object's asteroid class.

Name

```
readonly string Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.SkybotObject.Name
```

Name of the object.

PermanentDesignation

```
readonly? int Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.SkybotObject.PermanentDesignation
```

The object's permanent designation.

Position

```
readonly EquatorialPoint Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.SkybotObject.Position
```

[Position](#) of the object.

PositionUncertainty

```
readonly double Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.SkybotObject.PositionUncertainty
```

The object's position uncertainty.

TimeCoordinate

```
readonly DateTime Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.SkybotObject.TimeCoordinate
```

Time at which the object is at the specified position.

VisualMagnitude

```
readonly double Umbrella2.Pipeline.ExtraIO.SkyBoTLookup.SkybotObject.VisualMagnitude
```

The object's visual magnitude.

2.186 Umbrella2.Pipeline.EIOAlgorithms.SkyBoTPairing Class Reference

Provides an algorithm for pairing SkyBoT objects with tracklets.

Static Public Member Functions

- static void [FindNamesFromTree](#) (List< [Tracklet](#) > PairingObjects, [QuadTree](#)< SkybotObject > NamesTree, double MaxArcsecNaming)
Finds the names of a set of objects.
- static [QuadTree](#)< SkybotObject > [CreateTreeFromList](#) (IEnumerable< SkybotObject > NamesList)
Creates a QuadTree of SkyBoT objects for quick lookup.

Static Private Member Functions

- static void [PairTracklet](#) ([Tracklet](#) t, [QuadTree](#)< SkybotObject > NamesTree, double Separation)
Finds the (if there is any) name of the object.

2.186.1 Detailed Description

Provides an algorithm for pairing SkyBoT objects with tracklets.

2.186.2 Member Function Documentation

CreateTreeFromList()

```
static QuadTree< SkybotObject > Umbrella2.Pipeline.EIOAlgorithms.SkyBoTPairing.CreateTreeFromList (
    IEnumerable< SkybotObject > NamesList) [static]
```

Creates a QuadTree of SkyBoT objects for quick lookup.

Parameters

<i>NamesList</i>	List of SkyBoT objects.
------------------	-------------------------

FindNamesFromTree()

```
static void Umbrella2.Pipeline.EIOAlgorithms.SkyBoTPairing.FindNamesFromTree (
    List< Tracklet > PairingObjects,
    QuadTree< SkybotObject > NamesTree,
    double MaxArcsecNaming) [static]
```

Finds the names of a set of objects.

Parameters

<i>PairingObjects</i>	Objects to be named.
<i>NamesTree</i>	List of nearby SkyBoT objects.
<i>MaxArcsecNaming</i>	Maximum distance between SkyBoT object and detection at which they are considered the same object.

PairTracklet()

```
static void Umbrella2.Pipeline.EIOAlgorithms.SkyBoTPairing.PairTracklet (
    Tracklet t,
    QuadTree< SkybotObject > NamesTree,
    double Separation) [static], [private]
```

Finds the (if there is any) name of the object.

Parameters

<i>t</i>	Tracklet to process.
<i>NamesTree</i>	QuadTree of SkyBoT objects.
<i>Separation</i>	Maximum distance between SkyBoT object and detection at which they are considered the same object. Value in radians.

2.187 Umbrella2.Pipeline.ExtraIO.Ades.Software Class Reference**Public Attributes**

- string [Astrometry](#)
Description of software used for astrometry.
- string [FitOrder](#)
Order of fit for astrometric solution.
- string [Photometry](#)
Description of photometry software, if different from astrometry software.
- string [ObjectDetection](#)
Description of software for object detection, if different from astrometry or photometry software.

2.187.1 Member Data Documentation**Astrometry**

```
string Umbrella2.Pipeline.ExtraIO.Ades.Software.Astrometry
```

Description of software used for astrometry.

FitOrder

```
string Umbrella2.Pipeline.ExtraIO.Ades.Software.FitOrder
```

Order of fit for astrometric solution.

ObjectDetection

```
string Umbrella2.Pipeline.ExtraIO.Ades.Software.ObjectDetection
```

Description of software for object detection, if different from astrometry or photometry software.

Photometry

```
string Umbrella2.Pipeline.ExtraIO.Ades.Software.Photometry
```

Description of photometry software, if different from astrometry software.

2.188 Umbrella2.PropertyModel.CommonProperties.SourceEllipse Struct Reference

Represents an elliptical fit of a source's pixels.

Public Member Functions

- [SourceEllipse](#) (double XX, double XY, double YY)
Creates a new elliptical fit over a set of data.
- override string [ToString](#) ()

Public Attributes

- double [SemiaxisMajorAngle](#)
Trigonometric angle of the major semiaxis.
- double [SemiaxisMajor](#)
Major semiaxis of the elliptical fit.
- double [SemiaxisMinor](#)
Minor semiaxis of the elliptical fit.

2.188.1 Detailed Description

Represents an elliptical fit of a source's pixels.

2.188.2 Constructor & Destructor Documentation

SourceEllipse()

```
Umbrella2.PropertyModel.CommonProperties.SourceEllipse.SourceEllipse (  
    double XX,  
    double XY,  
    double YY)
```

Creates a new elliptical fit over a set of data.

Parameters

XX	Mean X*X.
XY	Mean X*Y.
YY	Mean Y*Y.

2.188.3 Member Function Documentation

ToString()

```
override string Umbrella2.PropertyModel.CommonProperties.SourceEllipse.ToString ()
```

2.188.4 Member Data Documentation

SemixaxisMajor

```
double Umbrella2.PropertyModel.CommonProperties.SourceEllipse.SemixaxisMajor
```

Major semiaxis of the elliptical fit.

SemixaxisMajorAngle

```
double Umbrella2.PropertyModel.CommonProperties.SourceEllipse.SemixaxisMajorAngle
```

Trigonometric angle of the major semiaxis.

SemixaxisMinor

```
double Umbrella2.PropertyModel.CommonProperties.SourceEllipse.SemixaxisMinor
```

Minor semiaxis of the elliptical fit.

2.189 Umbrella2.Pipeline.ExtraIO.SourceExtractor Class Reference

Classes

- struct [ObsEntry](#)

Static Public Member Functions

- static List< [ImageDetection](#) > [ParseSEFile](#) (IEnumerable< string > Lines, [FitsImage](#) AssociatedImage)
Parses a Source Extractor catalog file.

Static Private Member Functions

- static ? double [Parse](#) (Dictionary< string, int > Columns, string[] Data, string Value)
- static [ImageDetection Transform](#) ([ObsEntry](#) Entry, [FitsImage](#) AssociatedImage)

2.189.1 Member Function Documentation

Parse()

```
static ? double Umbrella2.Pipeline.ExtraIO.SourceExtractor.Parse (
    Dictionary< string, int > Columns,
    string[] Data,
    string Value) [static], [private]
```

ParseSEFile()

```
static List< ImageDetection > Umbrella2.Pipeline.ExtraIO.SourceExtractor.ParseSEFile (
    IEnumerable< string > Lines,
    FitsImage AssociatedImage) [static]
```

Parses a Source Extractor catalog file.

Returns

The detections in the catalog.

Parameters

<i>Lines</i>	Catalog file lines.
<i>AssociatedImage</i>	Image to which the catalog is associated to.

Transform()

```
static ImageDetection Umbrella2.Pipeline.ExtraIO.SourceExtractor.Transform (
    ObsEntry Entry,
    FitsImage AssociatedImage) [static], [private]
```

2.190 Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T > Class Template Reference

Data structure for fast retrieval of objects by their coordinates in a spherical coordinate system.

Classes

- class [QuadTreeNode](#)
Node of the QuadTree.

Public Member Functions

- [SphericalQuadTree](#) (int Depth)
Creates a new SphericalQuadTree of given depth.
- void [Add](#) (T Object, double Longitude, double Latitude)
Adds a new object to the tree.
- List< T > [Query](#) (double Longitude, double Latitude, double SquareSemiside)
Queries the tree for objects around a given point.

Private Attributes

- readonly int [Depth](#)
Tree depth.
- readonly [QuadTreeNode CylinderRoot](#)
Tree root for $-\pi/4 < \Delta < \pi/4$.
- readonly [QuadTreeNode BottomRoot](#)
Tree root for $\Delta < -\pi/4$.
- readonly [QuadTreeNode TopRoot](#)
Tree root for $\Delta > \pi/4$.

2.190.1 Detailed Description

Data structure for fast retrieval of objects by their coordinates in a spherical coordinate system.

2.190.2 Constructor & Destructor Documentation

SphericalQuadTree()

```
Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.SphericalQuadTree (
    int Depth)
```

Creates a new [SphericalQuadTree](#) of given depth.

Parameters

<i>Depth</i>	Tree depth. Number of branches to the lowest object bucket.
--------------	---

2.190.3 Member Function Documentation

Add()

```
void Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.Add (
    T Object,
    double Longitude,
    double Latitude)
```

Adds a new object to the tree.

Parameters

<i>Object</i>	Object to be added.
<i>Longitude</i>	The longitude of the object.
<i>Latitude</i>	The latitude of the object.

Query()

```
List< T > Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.Query (
    double Longitude,
    double Latitude,
    double SquareSemiside)
```

Queries the tree for objects around a given point.

Parameters

<i>Longitude</i>	Longitude of the center of the square.
<i>Latitude</i>	Latitude of the center of the square.
<i>SquareSemiside</i>	Distance from the center to the edges of the square.

Returns

2.190.4 Member Data Documentation

BottomRoot

```
readonly QuadTreeNode Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.BottomRoot
[private]
```

Tree root for $\Delta < -\pi/4$.

CylinderRoot

```
readonly QuadTreeNode Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.CylinderRoot
[private]
```

Tree root for $-\pi/4 < \Delta < \pi/4$.

Depth

```
readonly int Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.Depth [private]
```

Tree depth.

TopRoot

```
readonly QuadTreeNode Umbrella2.Algorithms.DataStructures.SphericalQuadTree< T >.TopRoot
[private]
```

Tree root for $\Delta > \pi/4$.

2.191 Umbrella2.Pipeline.ExtraIO.Ipef.Stamp Class Reference

Represents an individual stamp produced by the pipeline.

Public Attributes

- int [DetectionId](#)
ID of the detection to which this stamp refers. A value of -1 means it applies to the whole tracklet.
- string [File](#)
Name of the file containing the stamp (as a path to the parent folder of the stamps).

2.191.1 Detailed Description

Represents an individual stamp produced by the pipeline.

2.191.2 Member Data Documentation

DetectionId

```
int Umbrella2.Pipeline.ExtraIO.Ipef.Stamp.DetectionId
```

ID of the detection to which this stamp refers. A value of -1 means it applies to the whole tracklet.

File

```
string Umbrella2.Pipeline.ExtraIO.Ipef.Stamp.File
```

Name of the file containing the stamp (as a path to the parent folder of the stamps).

2.192 Umbrella2.Pipeline.ExtraIO.Ipef.StampSet Class Reference

Represents a set of stamps of a certain kind. Examples would be mean, median, masked or not.

Public Attributes

- string [SetName](#)
Name of the set. Should be unique.
- [Stamp\[\]](#) [Stamps](#)
The stamps that are part of the set.

2.192.1 Detailed Description

Represents a set of stamps of a certain kind. Examples would be mean, median, masked or not.

2.192.2 Member Data Documentation

SetName

```
string Umbrella2.Pipeline.ExtraIO.Ipef.StampSet.SetName
```

Name of the set. Should be unique.

Stamps

`Stamp` [] Umbrella2.Pipeline.ExtraIO.Ipef.StampSet.Stamps

The stamps that are part of the set.

2.193 Umbrella2.StandardDetectionFactory Class Reference

A set of standard methods of creating ImageDetections.

Static Public Member Functions

- static `ImageDetection CreateDetection (Image Image, IEnumerable< PixelPoint > Points, IEnumerable< double > Values)`
Creates a new `ImageDetection` from a given image, set of points and values. It also populates it with `Object←Photometry`, `ObjectPoints`, and `ObjectSize` properties.
- static void `MeasureDetection (IWCSProjection Transform, IEnumerable< PixelPoint > Points, IEnumerable< double > Values, out Position Pos, out ObjectSize Shape, out ObjectPhotometry Photometry, out ObjectPoints ObjPoints)`
Processes the raw pixel data into detection measurements.
- static `ImageDetection CreateDetection (Position Barycenter, ObservationTime Time, Image ParentImage)`
Wrapper for the original `ImageDetection` constructor.
- static `ImageDetection CreateDetection (Image Image, IEnumerable< PixelPoint > Points)`
Creates a new `ImageDetection` at a specified position in an image. Internally, fetches the intensities from the image at the given position and calls `CreateDetection(Image, IEnumerable<PixelPoint>, IEnumerable<double>)`.

2.193.1 Detailed Description

A set of standard methods of creating ImageDetections.

2.193.2 Member Function Documentation

CreateDetection() [1/3]

```
static ImageDetection Umbrella2.StandardDetectionFactory.CreateDetection (
    Image Image,
    IEnumerable< PixelPoint > Points) [static]
```

Creates a new `ImageDetection` at a specified position in an image. Internally, fetches the intensities from the image at the given position and calls `CreateDetection(Image, IEnumerable<PixelPoint>, IEnumerable<double>)`.

Parameters

<i>Image</i>	Image on which the object was detected.
<i>Points</i>	The set of pixels at which it has been detected.

Returns

The `ImageDetection` as from the expanded form.

CreateDetection() [2/3]

```
static ImageDetection Umbrella2.StandardDetectionFactory.CreateDetection (
    Image Image,
    IEnumerable< PixelPoint > Points,
    IEnumerable< double > Values) [static]
```

Creates a new [ImageDetection](#) from a given image, set of points and values. It also populates it with [ObjectPhotometry](#), [ObjectPoints](#), and [ObjectSize](#) properties.

Parameters

<i>Image</i>	Image on which the object was detected.
<i>Points</i>	The set of points on the image where it has been detected.
<i>Values</i>	The set of pixel intensities.

Returns

A new instance of [ImageDetection](#) with the specified extension properties.

CreateDetection() [3/3]

```
static ImageDetection Umbrella2.StandardDetectionFactory.CreateDetection (
    Position Barycenter,
    ObservationTime Time,
    Image ParentImage) [static]
```

Wrapper for the original [ImageDetection](#) constructor.

Parameters

<i>Barycenter</i>	Object barycenter.
<i>Time</i>	Time at which the object was observed.
<i>ParentImage</i>	Image on which the object was detected.

Returns**MeasureDetection()**

```
static void Umbrella2.StandardDetectionFactory.MeasureDetection (
    IWCSProjection Transform,
    IEnumerable< PixelPoint > Points,
    IEnumerable< double > Values,
    out Position Pos,
    out ObjectSize Shape,
    out ObjectPhotometry Photometry,
    out ObjectPoints ObjPoints) [static]
```

Processes the raw pixel data into detection measurements.

Parameters

<i>Transform</i>	WCS transformation to convert pixel coordinates into equatorial ones.
<i>Points</i>	The set of points on the image where it has been detected.
<i>Values</i>	The set of pixel intensities.
<i>Pos</i>	Detection position.
<i>Shape</i>	Shape of the object.
<i>Photometry</i>	Object flux.
<i>ObjPoints</i>	List of pixels, their equatorial coordinates and the flux of the detection.

2.194 Umbrella2.StandardTrackletFactory Class Reference

A set of standard methods for creating Tracklets.

Static Public Member Functions

- static [ImageDetection MergeStandardDetections](#) ([ImageDetection](#)[] Detections)
Creates a new [ImageDetection](#) by merging the blobs of other detections. Requires the input [ImageDetections](#) to have [ObjectPoints](#) property.
- static [Tracklet CreateTracklet](#) ([ImageDetection](#)[] Detections)
Creates a tracklet from a set of detections.

2.194.1 Detailed Description

A set of standard methods for creating Tracklets.

2.194.2 Member Function Documentation

CreateTracklet()

```
static Tracklet Umbrella2.StandardTrackletFactory.CreateTracklet (
    ImageDetection[] Detections) [static]
```

Creates a tracklet from a set of detections.

Parameters

<i>Detections</i>	Input detections; one per image.
-------------------	----------------------------------

Returns

A new [Tracklet](#) instance.

MergeStandardDetections()

```
static ImageDetection Umbrella2.StandardTrackletFactory.MergeStandardDetections (
    ImageDetection[] Detections) [static]
```

Creates a new [ImageDetection](#) by merging the blobs of other detections. Requires the input [ImageDetections](#) to have [ObjectPoints](#) property.

Parameters

<i>Detections</i>	The list of input detections to merge.
-------------------	--

Returns

A new instance of [ImageDetection](#).

2.195 Umbrella2.Algorithms.Filtering.Star Struct Reference

Represents a fixed star; used for filtering.

Public Attributes

- [EquatorialPoint EqCenter](#)
Star position in equatorial coordinates.
- [PixelPoint PixCenter](#)
Star position in pixel coordinates.
- double [PixRadius](#)
Star radius in pixels.
- [SourceEllipse Shape](#)
Elliptic fit of the star.
- double [Flux](#)
Star flux.

2.195.1 Detailed Description

Represents a fixed star; used for filtering.

2.195.2 Member Data Documentation

EqCenter

[EquatorialPoint](#) Umbrella2.Algorithms.Filtering.Star.EqCenter

[Star](#) position in equatorial coordinates.

Flux

double Umbrella2.Algorithms.Filtering.Star.Flux

[Star](#) flux.

PixCenter

`PixelPoint` Umbrella2.Algorithms.Filtering.Star.PixCenter

`Star` position in pixel coordinates.

PixRadius

`double` Umbrella2.Algorithms.Filtering.Star.PixRadius

`Star` radius in pixels.

Shape

`SourceEllipse` Umbrella2.Algorithms.Filtering.Star.Shape

Elliptic fit of the star.

2.196 Umbrella2.Algorithms.Filtering.StarData Class Reference

Class representing information about fixed stars. Used for filtering.

Public Member Functions

- void `MarkStarCrossed` (IEnumerable< `ImageDetection` > Detections, double StarMultiplier, double MinStarFlux)
Marks detections that cross near a star (and therefore could well be parts of the star's halo).

Public Attributes

- List< `Star` > `FixedStarList` = new List<`Star`>()

2.196.1 Detailed Description

Class representing information about fixed stars. Used for filtering.

2.196.2 Member Function Documentation

MarkStarCrossed()

```
void Umbrella2.Algorithms.Filtering.StarData.MarkStarCrossed (
    IEnumerable< ImageDetection > Detections,
    double StarMultiplier,
    double MinStarFlux)
```

Marks detections that cross near a star (and therefore could well be parts of the star's halo).

Parameters

<i>Detections</i>	List of the detections to analyze.
<i>StarMultiplier</i>	Ratio between the radius of star pollution marking and the star radius.
<i>MinStarFlux</i>	Minimum flux of a fixed object before it marks nearby objects as star-crossing.

2.196.3 Member Data Documentation**FixedStarList**

```
List<Star> Umbrella2.Algorithms.Filtering.StarData.FixedStarList = new List<Star>()
```

2.197 Umbrella2.Pipeline.ExtraIO.VizieR.StarInfo Struct Reference

Star data as provided from [VizieR](#).

Public Attributes

- [EquatorialPoint](#) Coordinate
- double [Magnitude](#)

2.197.1 Detailed Description

Star data as provided from [VizieR](#).

2.197.2 Member Data Documentation**Coordinate**

```
EquatorialPoint Umbrella2.Pipeline.ExtraIO.VizieR.StarInfo.Coordinate
```

Magnitude

```
double Umbrella2.Pipeline.ExtraIO.VizieR.StarInfo.Magnitude
```

2.198 Umbrella2.Pipeline.ExtraIO.Ades.Submitter Class Reference**Public Attributes**

- string [Name](#)
Name of individual submitting data to MPC.
- string [Institution](#)
Affiliation of submitter.

2.198.1 Member Data Documentation

Institution

```
string Umbrella2.Pipeline.ExtraIO.Ades.Submitter.Institution
```

Affiliation of submitter.

Name

```
string Umbrella2.Pipeline.ExtraIO.Ades.Submitter.Name
```

Name of individual submitting data to MPC.

2.199 Umbrella2.IO.FITS.KnownKeywords.SWarpScaling Class Reference

Handles scaling of image data according to SWarp headers.

Public Member Functions

- [SWarpScaling \(Image File\)](#)
- override List< [MetadataRecord](#) > [GetRecords](#) ()
- void [ScaleData](#) (double[,] Input)
Scales image data according to SWarp headers.

Public Member Functions inherited from [Umbrella2.IO.ImageProperties](#)

- [ImageProperties \(Image Image\)](#)
Creates a new instance of the image properties for the given image.
- List< [MetadataRecord](#) > [GetRecords](#) ()
Gets the list of metadata records associated with the property.

Public Attributes

- readonly double [FlxScale](#)
SWarp FLXSCALE parameter.
- readonly double [BackMean](#)
Background mean - SWarp BACKMEAN parameter.
- readonly double [BackSig](#)
Background standard deviation - SWarp BACKSIG parameter.

Static Public Attributes

- static bool [ThrowSwarpHeaders](#) = false
If.
- static bool [ApplyTransform](#)
Switch for turning on/off [SWarpScaling](#) compensations. Implemented since some processing pipelines mess up the scaling.

2.199.1 Detailed Description

Handles scaling of image data according to SWarp headers.

2.199.2 Constructor & Destructor Documentation

SWarpScaling()

```
Umbrella2.IO.FITS.KnownKeywords.SWarpScaling.SWarpScaling (  
    Image File)
```

2.199.3 Member Function Documentation

GetRecords()

```
override List< MetadataRecord > Umbrella2.IO.FITS.KnownKeywords.SWarpScaling.GetRecords ()
```

ScaleData()

```
void Umbrella2.IO.FITS.KnownKeywords.SWarpScaling.ScaleData (  
    double Input[,])
```

Scales image data according to SWarp headers.

Parameters

<i>Input</i>	Input image data.
--------------	-------------------

2.199.4 Member Data Documentation

ApplyTransform

```
bool Umbrella2.IO.FITS.KnownKeywords.SWarpScaling.ApplyTransform [static]
```

Switch for turning on/off [SWarpScaling](#) compensations. Implemented since some processing pipelines mess up the scaling.

BackMean

```
readonly double Umbrella2.IO.FITS.KnownKeywords.SWarpScaling.BackMean
```

Background mean - SWarp BACKMEAN parameter.

BackSig

```
readonly double Umbrella2.IO.FITS.KnownKeywords.SWarpScaling.BackSig
```

Background standard deviation - SWarp BACKSIG parameter.

FlxScale

```
readonly double Umbrella2.IO.FITS.KnownKeywords.SWarpScaling.FlxScale
```

SWarp FLXSCALE parameter.

ThrowSwarfHeaders

```
bool Umbrella2.IO.FITS.KnownKeywords.SWarpScaling.ThrowSwarfHeaders = false [static]
```

```
if.
true
```

```
, throw if SWarp headeres are not present in the image. If
false
```

, set scaling ([FlxScale](#)) to identity.

2.200 Umbrella2.WCS.Projections.TAN Class Reference

Gnomonic projection algorithm for image [WCS](#).

Public Member Functions

- [TAN](#) (double [RA](#), double [Dec](#))
- override [EquatorialPoint](#) [GetEquatorialPoint](#) ([ProjectionPoint](#) Point)
- override [EquatorialPoint\[\]](#) [GetEquatorialPoints](#) ([ProjectionPoint\[\]](#) Points)
- override List< [EquatorialPoint](#) > [GetEquatorialPoints](#) (IEnumerable< [ProjectionPoint](#) > Points)
- override [EquatorialVelocity](#) [GetEquatorialVelocity](#) ([ProjectionVelocity](#) PV)
- override double [GetEstimatedWCSChainDerivative](#) ()
- override [ProjectionPoint](#) [GetProjectionPoint](#) ([EquatorialPoint](#) Point)
- override [ProjectionPoint\[\]](#) [GetProjectionPoints](#) ([EquatorialPoint\[\]](#) Points)
- override List< [ProjectionPoint](#) > [GetProjectionPoints](#) (IEnumerable< [EquatorialPoint](#) > Points)
- override [ProjectionVelocity](#) [GetProjectionVelocity](#) ([EquatorialVelocity](#) EV)
- override void [GetReferencePoints](#) (out double [RA](#), out double [Dec](#))

Public Member Functions inherited from [Umbrella2.WCS.WCSProjectionTransform](#)

- [WCSProjectionTransform](#) (double [RA](#), double [Dec](#))
- [EquatorialPoint](#) [GetEquatorialPoint](#) ([ProjectionPoint](#) [Point](#))
- [EquatorialPoint\[\]](#) [GetEquatorialPoints](#) ([ProjectionPoint\[\]](#) [Points](#))
- List< [EquatorialPoint](#) > [GetEquatorialPoints](#) (IEnumerable< [ProjectionPoint](#) > [Points](#))
- [ProjectionPoint](#) [GetProjectionPoint](#) ([EquatorialPoint](#) [Point](#))
- [ProjectionPoint\[\]](#) [GetProjectionPoints](#) ([EquatorialPoint\[\]](#) [Points](#))
- List< [ProjectionPoint](#) > [GetProjectionPoints](#) (IEnumerable< [EquatorialPoint](#) > [Points](#))
- [EquatorialVelocity](#) [GetEquatorialVelocity](#) ([ProjectionVelocity](#) [PV](#))
- [ProjectionVelocity](#) [GetProjectionVelocity](#) ([EquatorialVelocity](#) [EV](#))
- double [GetEstimatedWCSChainDerivative](#) ()

Estimated linear distance derivative for quick computation of image distances and velocities.

- void [GetReferencePoints](#) (out double [RA](#), out double [Dec](#))

Retrieves the coordinates of the reference point of the projection.

Static Public Attributes

- const string [AlgorithmName](#) = "TAN"
- const string [AlgorithmDescription](#) = "Gnomonic projection."

Properties

- override string [Name](#) [get]
- override string [Description](#) [get]

Properties inherited from [Umbrella2.WCS.WCSProjectionTransform](#)

- string [Name](#) [get]
Name of the projection algorithm (tag).
- string [Description](#) [get]
Description of the projection algorithm (ex. full algorithm name).

Static Private Attributes

- const double [ADDC](#) = 144.0 / double.MaxValue
This epsilon constant is used to avoid a 0/0 division in computing Decn in the code below.

Additional Inherited Members

Protected Attributes inherited from [Umbrella2.WCS.WCSProjectionTransform](#)

- readonly double [RA](#)
Reference point Right Ascension.
- readonly double [Dec](#)
Reference point Declination.

2.200.1 Detailed Description

Gnomonic projection algorithm for image [WCS](#).

2.200.2 Constructor & Destructor Documentation

TAN()

```
Umbrella2.WCS.Projections.TAN.TAN (  
    double RA,  
    double Dec)
```

2.200.3 Member Function Documentation

GetEquatorialPoint()

```
override EquatorialPoint Umbrella2.WCS.Projections.TAN.GetEquatorialPoint (  
    ProjectionPoint Point)
```

GetEquatorialPoints() [1/2]

```
override List< EquatorialPoint > Umbrella2.WCS.Projections.TAN.GetEquatorialPoints (  
    IEnumerable< ProjectionPoint > Points)
```

GetEquatorialPoints() [2/2]

```
override EquatorialPoint[] Umbrella2.WCS.Projections.TAN.GetEquatorialPoints (  
    ProjectionPoint[] Points)
```

GetEquatorialVelocity()

```
override EquatorialVelocity Umbrella2.WCS.Projections.TAN.GetEquatorialVelocity (  
    ProjectionVelocity PV)
```

GetEstimatedWCSChainDerivative()

```
override double Umbrella2.WCS.Projections.TAN.GetEstimatedWCSChainDerivative ()
```

GetProjectionPoint()

```
override ProjectionPoint Umbrella2.WCS.Projections.TAN.GetProjectionPoint (  
    EquatorialPoint Point)
```

GetProjectionPoints() [1/2]

```
override ProjectionPoint[] Umbrella2.WCS.Projections.TAN.GetProjectionPoints (
    EquatorialPoint[] Points)
```

GetProjectionPoints() [2/2]

```
override List< ProjectionPoint > Umbrella2.WCS.Projections.TAN.GetProjectionPoints (
    IEnumerable< EquatorialPoint > Points)
```

GetProjectionVelocity()

```
override ProjectionVelocity Umbrella2.WCS.Projections.TAN.GetProjectionVelocity (
    EquatorialVelocity EV)
```

GetReferencePoints()

```
override void Umbrella2.WCS.Projections.TAN.GetReferencePoints (
    out double RA,
    out double Dec)
```

2.200.4 Member Data Documentation**ADDC**

```
const double Umbrella2.WCS.Projections.TAN.ADDC = 144.0 / double.MaxValue [static], [private]
```

This epsilon constant is used to avoid a 0/0 division in computing Decn in the code below.

AlgorithmDescription

```
const string Umbrella2.WCS.Projections.TAN.AlgorithmDescription = "Gnomonic projection." [static]
```

AlgorithmName

```
const string Umbrella2.WCS.Projections.TAN.AlgorithmName = "TAN" [static]
```

2.200.5 Property Documentation**Description**

```
override string Umbrella2.WCS.Projections.TAN.Description [get]
```


Name

```
override string Umbrella2.WCS.Projections.TAN.Name [get]
```

2.201 Umbrella2.Pipeline.ExtraIO.Ades.Telescope Class Reference

Public Attributes

- string [Name](#)
Name of observatory or telescope.
- string [Design](#)
Telescope design, e.g., reflector, Schmidt, Schmidt-Cassegrain.
- double? [Aperture](#)
Telescope aperture in meters.
- string [Detector](#)
Type of detector, e.g., 'CCD'.
- double? [FRatio](#)
Telescope f-number, the ratio of telescope focal length to aperture.
- string [Filter](#)
Description of telescope filter(s).
- string [ArraySize](#)
Array size (X`Y), after binning, of the individual detector chip.
- double? [PixelScale](#)
Angular extent of pixel in arcseconds(geometric mean of x and y extents for non-square pixels).

2.201.1 Member Data Documentation

Aperture

```
double? Umbrella2.Pipeline.ExtraIO.Ades.Telescope.Aperture
```

[Telescope](#) aperture in meters.

ArraySize

```
string Umbrella2.Pipeline.ExtraIO.Ades.Telescope.ArraySize
```

Array size (X`Y), after binning, of the individual detector chip.

Design

```
string Umbrella2.Pipeline.ExtraIO.Ades.Telescope.Design
```

[Telescope](#) design, e.g., reflector, Schmidt, Schmidt-Cassegrain.

Detector

```
string Umbrella2.Pipeline.ExtraIO.Ades.Telescope.Detector
```

Type of detector, e.g., 'CCD'.

Filter

```
string Umbrella2.Pipeline.ExtraIO.Ades.Telescope.Filter
```

Description of telescope filter(s).

FRatio

```
double? Umbrella2.Pipeline.ExtraIO.Ades.Telescope.FRatio
```

[Telescope](#) f-number, the ratio of telescope focal length to aperture.

Name

```
string Umbrella2.Pipeline.ExtraIO.Ades.Telescope.Name
```

Name of observatory or telescope.

PixelScale

```
double? Umbrella2.Pipeline.ExtraIO.Ades.Telescope.PixelScale
```

Angular extent of pixel in arcseconds(geometric mean of x and y extents for non-square pixels).

2.202 Umbrella2.Algorithms.Images.Schedulers.SchedUtil.ThreadDetails Struct Reference

Thread-specific parameter bag. Can be used for implementing threaded schedulers.

Public Attributes

- int [StartPosition](#)
Y coordinate at which the thread should start processing.
- int [EndPosition](#)
Y coordinate at which the thread should end processing.
- int [CurrentPositionX](#)
Current Y coordinate.
- int [CurrentPositionY](#)
Current X coordinate.

2.202.1 Detailed Description

Thread-specific parameter bag. Can be used for implementing threaded schedulers.

2.202.2 Member Data Documentation

CurrentPositionX

```
int Umbrella2.Algorithms.Images.Schedulers.SchedUtil.ThreadDetails.CurrentPositionX
```

Current Y coordinate.

CurrentPositionY

```
int Umbrella2.Algorithms.Images.Schedulers.SchedUtil.ThreadDetails.CurrentPositionY
```

Current X coordinate.

EndPosition

```
int Umbrella2.Algorithms.Images.Schedulers.SchedUtil.ThreadDetails.EndPosition
```

Y coordinate at which the thread should end processing.

StartPosition

```
int Umbrella2.Algorithms.Images.Schedulers.SchedUtil.ThreadDetails.StartPosition
```

Y coordinate at which the thread should start processing.

2.203 Umbrella2.Tracklet Class Reference

An object candidate.

Public Member Functions

- [Tracklet](#) ([ImageDetection\[\]](#) [Detections](#), [TrackletVelocity](#) [Velocity](#), [TrackletVelocityRegression](#) [Regression](#))
Creates a [Tracklet](#) from the given arguments. This constructor is internally called by the [Tracklet](#) factories.
- [Tracklet](#) ()
Empty constructor, for easier use with reflection.
- [T](#) [FetchProperty](#)< [T](#) > ()
Fetches a property of the [ImageDetection](#). Not thread-safe when also appending properties concurrently.
- [bool](#) [TryFetchProperty](#)< [T](#) > (out [T](#) [Property](#))
Tries fetching a property of the [ImageDetection](#).
- [T](#) [FetchOrCreate](#)< [T](#) > ()
Tries fetching a property of the [ImageDetection](#) or creates a new one.
- [void](#) [AppendProperty](#)< [T](#) > ([T](#) [Property](#))
Appends a property to the object.
- [void](#) [SetResetProperty](#)< [T](#) > ([T](#) [Property](#))
Appends or overwrites a property.

Public Attributes

- readonly [ImageDetection\[\] Detections](#)
Object instances that form the tracklet.
- readonly [TrackletVelocity Velocity](#)
Object velocity.
- readonly [TrackletVelocityRegression VelReg](#)
Represents the tracklet's velocity regression parameters.

Properties

- Dictionary< Type, [IExtensionProperty](#) > [ExtendedProperties](#) [get]
List of supplementary properties.

Properties inherited from [Umbrella2.PropertyModel.IExtendable](#)

2.203.1 Detailed Description

An object candidate.

2.203.2 Constructor & Destructor Documentation

Tracklet() [1/2]

```
Umbrella2.Tracklet.Tracklet (
    ImageDetection[] Detections,
    TrackletVelocity Velocity,
    TrackletVelocityRegression Regression)
```

Creates a [Tracklet](#) from the given arguments. This constructor is internally called by the [Tracklet](#) factories.

Tracklet() [2/2]

```
Umbrella2.Tracklet.Tracklet ()
```

Empty constructor, for easier use with reflection.

2.203.3 Member Function Documentation

AppendProperty< T >()

```
void Umbrella2.Tracklet.AppendProperty< T > (
    T Property)
```

Appends a property to the object.

Note that this function sets the property type according to the generic type parameter.

Template Parameters

<i>T</i>	Property type.
----------	----------------

Parameters

<i>Property</i>	Property instance.
-----------------	--------------------

Implements [Umbrella2.PropertyModel.IExtendable](#).

Type Constraints

T : IExtensionProperty

FetchOrCreate< T >()

`T Umbrella2.Tracklet.FetchOrCreate< T > ()`

Tries fetching a property of the [ImageDetection](#) or creates a new one.

Template Parameters

<i>T</i>	Property type.
----------	----------------

Returns

Property instance on the object or the default value of the type.

Implements [Umbrella2.PropertyModel.IExtendable](#).

Type Constraints

T : IExtensionProperty

T : new()

FetchProperty< T >()

`T Umbrella2.Tracklet.FetchProperty< T > ()`

Fetches a property of the [ImageDetection](#). Not thread-safe when also appending properties concurrently.

Template Parameters

<i>T</i>	Property type.
----------	----------------

Returns

The property, casted to the appropriate type.

Implements [Umbrella2.PropertyModel.IExtendable](#).

Type Constraints

T : IExtensionProperty

SetResetProperty< T >()

```
void Umbrella2.Tracklet.SetResetProperty< T > (  
    T Property)
```

Appends or overwrites a property.

Template Parameters

<i>T</i>	Property type.
----------	----------------

Parameters

<i>Property</i>	Property instance.
-----------------	--------------------

Implements [Umbrella2.PropertyModel.IExtendable](#).

Type Constraints

T : IExtensionProperty

TryFetchProperty< T >()

```
bool Umbrella2.Tracklet.TryFetchProperty< T > (  
    out T Property)
```

Tries fetching a property of the [ImageDetection](#).

Template Parameters

<i>T</i>	Property type.
----------	----------------

Parameters

<i>Property</i>	Property instance on the object.
-----------------	----------------------------------

Returns

True if property exists.

Implements [Umbrella2.PropertyModel.IExtendable](#).

Type Constraints

T : IExtensionProperty

T : new()

2.203.4 Member Data Documentation

Detections

readonly [ImageDetection](#) [] Umbrella2.Tracklet.Detections

Object instances that form the tracklet.

Velocity

readonly [TrackletVelocity](#) Umbrella2.Tracklet.Velocity

Object velocity.

VelReg

readonly [TrackletVelocityRegression](#) Umbrella2.Tracklet.VelReg

Represents the tracklet's velocity regression parameters.

2.203.5 Property Documentation

ExtendedProperties

Dictionary<Type, [IExtensionProperty](#)> Umbrella2.Tracklet.ExtendedProperties [get]

List of supplementary properties.

The held values should be reference types; otherwise boxing will make them read-only.

Implements [Umbrella2.PropertyModel.IExtendable](#).

2.204 Umbrella2.Algorithms.Filtering.TrackletFilters Class Reference

Provides filtering for tracklets.

Static Public Member Functions

- static List< [Tracklet](#) > [Filter](#) (List< [Tracklet](#) > Input, params Predicate< [Tracklet](#) >[] Filters)
Runs the given filters in parallel over the input.

2.204.1 Detailed Description

Provides filtering for tracklets.

2.204.2 Member Function Documentation

Filter()

```
static List< Tracklet > Umbrella2.Algorithms.Filtering.TrackletFilters.Filter (
    List< Tracklet > Input,
    params Predicate< Tracklet >[] Filters) [static]
```

Runs the given filters in parallel over the input.

Parameters

<i>Input</i>	Input sources.
<i>Filters</i>	Filters to be run. Each filter should return true for the tracklet to pass.

Returns

Filtered tracklets.

2.205 Umbrella2.Visualizer.WinForms.TrackletOutput Class Reference

Provides a visualization mechanism for tracklets.

Public Member Functions

- [TrackletOutput](#) (string Name)

Parameters

Name	<i>Shown name of the current list.</i>
------	--

- void [AddCCD](#) (int CCDNum, List< [Tracklet](#) > Tracklets, IList< [IO.Image](#) > [Images](#))
Adds a CCD to the tracklet output.

Public Attributes

- string [ObservatoryCode](#)
MPC Observatory code.
- string [ReportName](#)
Name of the file to which the report is written.
- string [FieldName](#)
Name of the processed field.
- string [ReportFieldName](#)
Name of the processed field as given to the objects in the report.
- MPCOpticalReportFormat.MagnitudeBand [Band](#)
Band of the observations.

Protected Member Functions

- override void [Dispose](#) (bool disposing)
Clean up any resources being used.

Properties

- List< [Tracklet](#) > [CurrentTracklets](#) [get]
Displayed tracklets.

Private Member Functions

- void [TrackletOutput_Load](#) (object sender, EventArgs e)
- void [checkedListBox1_SelectedIndexChanged](#) (object sender, EventArgs e)
- void [SelectedTrackletChanged](#) ()
The selected tracklet changed.
- void [UpdateProperties](#) ()
Update the properties grid for the tracklet.
- void [AddTrackletProperties](#) (object[] Properties)
- void [dataGridView1_SelectionChanged](#) (object sender, EventArgs e)
- void [UpdateImage](#) ()
- void [SelectObject](#) (int Index)
The selected tracklet detection changed.
- void [UpdateDetectionProperties](#) ()
- void [EnsureDetectionCMS](#) ()
Ensures that the detection ContextMenuStrip is populated.
- void [button1_Click](#) (object sender, EventArgs e)
- void [tabControl1_SelectedIndexChanged](#) (object sender, EventArgs e)
- void [InitializeComponent](#) ()
Required method for Designer support - do not modify the contents of this method with the code editor.
- void [BlinkOnDetection](#) ()
Toggle blinking of images.
- void [BlinkNext](#) ()
Changes to the next image to blink.
- void [Filter](#) (ImageDetection Detection)
Filters tracklets dependent on a Detection from the list.
- delegate bool [DetectionFilteringCondition](#) (ImageDetection Filterer, ImageDetection Filtered, double Parameter)
Represents a predicate for filtering ImageDetections.
- void [FilterByDetection](#) (ImageDetection Detection, DetectionFilteringCondition Filter, double Parameter)
Filters detections matching a condition.
- void [HandleKeyPress](#) (char Key)
Provides custom navigation according to the key pressed.
- void [ViewObjectProperties](#) ()
- void [RefreshTrackletList](#) ()
Refreshes the list of tracklets after a change.
- void [RefreshTabTrackletsList](#) (int TabNum)
- void [CreateMPCReport](#) (StringBuilder Report)
Generates the report from the selected tracklets.
- void [TrackletOutput_KeyPress](#) (object sender, KeyPressEventEventArgs e)
- void [SkyBotLookupNames](#) (double ArcLengthSec)
Function for looking up the names of objects.
- void [viewPropertiesToolStripMenuItem_Click](#) (object sender, EventArgs e)

Static Private Member Functions

- static bool [ConditionRadius](#) (ImageDetection Detection, ImageDetection x, double RadRadius)
Filters all detections within a RadRadius radius from the Detection .
- static bool [ConditionX](#) (ImageDetection Detection, ImageDetection x, double XDelta)
Filters all detection with X coordinates within XDelta from the Detection .
- static bool [ConditionY](#) (ImageDetection Detection, ImageDetection x, double YDelta)
Filters all detection with Y coordinates within YDelta from the Detection .

Private Attributes

- List< List< [Tracklet](#) > > [m_tracklets](#)
- int [CurrentCCD](#)
- int [SelectedTracklet](#)
- [ImageDetection](#) [SelectedDetection](#)
- List< int > [CCDNumbers](#)
Number of the processed CCD.
- List< IList< [IO.Image](#) > > [OriginalImageCube](#)
All original input images.
- readonly string [ListName](#)
Name of the list of tracklets.
- string [CurrentImageName](#)
Name of the currently viewed image in its image set.
- Dictionary< string, [IO.Image](#) > [Images](#)
Images that can be loaded for viewing.
- Timer [BlinkTimer](#)
Timer for the blink function.
- int [BlinkID](#)
Blink image number.
- bool [SuspendObjectsUpdate](#) = false
Disable the object number update callback. Used when updating tracklets to prevent the callback from firing while the list mutates.
- CheckedListBox [checkedListBox1](#)
Currently selected list of tracklets.
- System.ComponentModel.IContainer [components](#) = null
Required designer variable.
- System.Windows.Forms.Panel [panel2](#)
- System.Windows.Forms.Panel [panel1](#)
- System.Windows.Forms.Button [button1](#)
- System.Windows.Forms.DataGridView [dataGridView2](#)
- System.Windows.Forms.DataGridView [dataGridView3](#)
- System.Windows.Forms.DataGridViewTextBoxColumn [PropertyName1](#)
- System.Windows.Forms.DataGridViewTextBoxColumn [PropertyValue1](#)
- System.Windows.Forms.DataGridViewTextBoxColumn [PropertyName2](#)
- System.Windows.Forms.DataGridViewTextBoxColumn [PropertyValue2](#)
- System.Windows.Forms.ContextMenuStrip [contextMenuStrip1](#)
- System.Windows.Forms.ContextMenuStrip [contextMenuStrip2](#)
- System.Windows.Forms.ContextMenuStrip [contextMenuStrip3](#)
- [FitsView](#) [ImageView](#)
- System.Windows.Forms.TabControl [tabControl1](#)
- System.Windows.Forms.DataGridView [dataGridView1](#)
- System.Windows.Forms.DataGridViewTextBoxColumn [Column1](#)
- System.Windows.Forms.DataGridViewTextBoxColumn [Column2](#)
- System.Windows.Forms.DataGridViewTextBoxColumn [Column3](#)
- System.Windows.Forms.DataGridViewTextBoxColumn [Column4](#)
- System.Windows.Forms.DataGridViewTextBoxColumn [Column5](#)
- System.Windows.Forms.DataGridViewTextBoxColumn [Column6](#)
- System.Windows.Forms.DataGridViewTextBoxColumn [Column7](#)
- System.Windows.Forms.ToolStripMenuItem [viewPropertiesToolStripMenuItem](#)

2.205.1 Detailed Description

Provides a visualization mechanism for tracklets.

2.205.2 Constructor & Destructor Documentation

TrackletOutput()

```
Umbrella2.Visualizer.WinForms.TrackletOutput.TrackletOutput (
    string Name)
```

Parameters

<i>Name</i>	Shown name of the current list.
-------------	---------------------------------

2.205.3 Member Function Documentation

AddCCD()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.AddCCD (
    int CCDNum,
    List< Tracklet > Tracklets,
    IList< IO.Image > Images)
```

Adds a CCD to the tracklet output.

Parameters

<i>CCDNum</i>	CCD Number.
<i>Tracklets</i>	Tracklets detected.
<i>Images</i>	Original pipeline images.

AddTrackletProperties()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.AddTrackletProperties (
    object Properties[[]]) [private]
```

BlinkNext()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.BlinkNext () [private]
```

Changes to the next image to blink.

BlinkOnDetection()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.BlinkOnDetection () [private]
```

Toggle blinking of images.

button1_Click()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.button1_Click (  
    object sender,  
    EventArgs e) [private]
```

checkedListBox1_SelectedIndexChanged()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.checkedListBox1_SelectedIndexChanged (  
    object sender,  
    EventArgs e) [private]
```

ConditionRadius()

```
static bool Umbrella2.Visualizer.WinForms.TrackletOutput.ConditionRadius (  
    ImageDetection Detection,  
    ImageDetection x,  
    double RadRadius) [static], [private]
```

Filters all detections within a *RadRadius* radius from the *Detection* .

ConditionX()

```
static bool Umbrella2.Visualizer.WinForms.TrackletOutput.ConditionX (  
    ImageDetection Detection,  
    ImageDetection x,  
    double XDelta) [static], [private]
```

Filters all detection with X coordinates within *XDelta* from the *Detection* .

ConditionY()

```
static bool Umbrella2.Visualizer.WinForms.TrackletOutput.ConditionY (  
    ImageDetection Detection,  
    ImageDetection x,  
    double YDelta) [static], [private]
```

Filters all detection with Y coordinates within *YDelta* from the *Detection* .

CreateMPCReport()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.CreateMPCReport (  
    StringBuilder Report) [private]
```

Generates the report from the selected tracklets.

Parameters

<i>Report</i>	StringBuilder to collect the report.
---------------	--------------------------------------

dataGridView1_SelectionChanged()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.dataGridView1_SelectionChanged (
    object sender,
    EventArgs e) [private]
```

DetectionFilteringCondition()

```
delegate bool Umbrella2.Visualizer.WinForms.TrackletOutput.DetectionFilteringCondition (
    ImageDetection Filterer,
    ImageDetection Filtered,
    double Parameter) [private]
```

Represents a predicate for filtering [ImageDetections](#).

Dispose()

```
override void Umbrella2.Visualizer.WinForms.TrackletOutput.Dispose (
    bool disposing) [protected]
```

Clean up any resources being used.

Parameters

<i>disposing</i>	true if managed resources should be disposed; otherwise, false.
------------------	---

EnsureDetectionCMS()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.EnsureDetectionCMS () [private]
```

Ensures that the detection ContextMenuStrip is populated.

Filter()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.Filter (
    ImageDetection Detection) [private]
```

Filters tracklets dependent on a *Detection* from the list.

FilterByDetection()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.FilterByDetection (
    ImageDetection Detection,
    DetectionFilteringCondition Filter,
    double Parameter) [private]
```

Filters detections matching a condition.

Parameters

<i>Detection</i>	Model detection.
<i>Filter</i>	Filtering predicate.
<i>Parameter</i>	Predicate parameter.

HandleKeyPress()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.HandleKeyPress (
    char Key) [private]
```

Provides custom navigation according to the key pressed.

Parameters

<i>Key</i>	Pressed key char.
------------	-------------------

InitializeComponent()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.InitializeComponent () [private]
```

Required method for Designer support - do not modify the contents of this method with the code editor.

RefreshTabTrackletsList()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.RefreshTabTrackletsList (
    int TabNum) [private]
```

RefreshTrackletList()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.RefreshTrackletList () [private]
```

Refreshes the list of tracklets after a change.

SelectedTrackletChanged()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.SelectedTrackletChanged () [private]
```

The selected tracklet changed.

SelectObject()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.SelectObject (
    int Index) [private]
```

The selected tracklet detection changed.

Parameters

<i>Index</i>	Detection number.
--------------	-------------------

SkyBotLookupNames()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.SkyBotLookupNames (
    double ArcLengthSec) [private]
```

Function for looking up the names of objects.

Parameters

<i>ArcLengthSec</i>	Lookup radius.
---------------------	----------------

tabControl1_SelectedIndexChanged()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.tabControl1_SelectedIndexChanged (
    object sender,
    EventArgs e) [private]
```

TrackletOutput_KeyPress()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.TrackletOutput_KeyPress (
    object sender,
    KeyPressEventArgs e) [private]
```

TrackletOutput_Load()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.TrackletOutput_Load (
    object sender,
    EventArgs e) [private]
```

UpdateDetectionProperties()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.UpdateDetectionProperties () [private]
```

UpdateImage()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.UpdateImage () [private]
```

UpdateProperties()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.UpdateProperties () [private]
```

Update the properties grid for the tracklet.

ViewObjectProperties()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.ViewObjectProperties () [private]
```

viewPropertiesToolStripMenuItem_Click()

```
void Umbrella2.Visualizer.WinForms.TrackletOutput.viewPropertiesToolStripMenuItem_Click (  
    object sender,  
    EventArgs e) [private]
```

2.205.4 Member Data Documentation**Band**

```
MPCOpticalReportFormat.MagnitudeBand Umbrella2.Visualizer.WinForms.TrackletOutput.Band
```

Band of the observations.

BlinkID

```
int Umbrella2.Visualizer.WinForms.TrackletOutput.BlinkID [private]
```

Blink image number.

BlinkTimer

```
Timer Umbrella2.Visualizer.WinForms.TrackletOutput.BlinkTimer [private]
```

Timer for the blink function.

button1

```
System.Windows.Forms.Button Umbrella2.Visualizer.WinForms.TrackletOutput.button1 [private]
```

CCDNumbers

```
List<int> Umbrella2.Visualizer.WinForms.TrackletOutput.CCDNumbers [private]
```

Number of the processed CCD.

checkedListBox1

```
CheckedListBox Umbrella2.Visualizer.WinForms.TrackletOutput.checkedListBox1 [private]
```

Currently selected list of tracklets.

Column1

System.Windows.Forms.DataGridViewTextBoxColumn Umbrella2.Visualizer.WinForms.TrackletOutput.↔
Column1 [private]

Column2

System.Windows.Forms.DataGridViewTextBoxColumn Umbrella2.Visualizer.WinForms.TrackletOutput.↔
Column2 [private]

Column3

System.Windows.Forms.DataGridViewTextBoxColumn Umbrella2.Visualizer.WinForms.TrackletOutput.↔
Column3 [private]

Column4

System.Windows.Forms.DataGridViewTextBoxColumn Umbrella2.Visualizer.WinForms.TrackletOutput.↔
Column4 [private]

Column5

System.Windows.Forms.DataGridViewTextBoxColumn Umbrella2.Visualizer.WinForms.TrackletOutput.↔
Column5 [private]

Column6

System.Windows.Forms.DataGridViewTextBoxColumn Umbrella2.Visualizer.WinForms.TrackletOutput.↔
Column6 [private]

Column7

System.Windows.Forms.DataGridViewTextBoxColumn Umbrella2.Visualizer.WinForms.TrackletOutput.↔
Column7 [private]

components

System.ComponentModel.IContainer Umbrella2.Visualizer.WinForms.TrackletOutput.components =
null [private]

Required designer variable.

contextMenuStrip1

```
System.Windows.Forms.ContextMenuStrip Umbrella2.Visualizer.WinForms.TrackletOutput.context↔  
MenuStrip1 [private]
```

contextMenuStrip2

```
System.Windows.Forms.ContextMenuStrip Umbrella2.Visualizer.WinForms.TrackletOutput.context↔  
MenuStrip2 [private]
```

contextMenuStrip3

```
System.Windows.Forms.ContextMenuStrip Umbrella2.Visualizer.WinForms.TrackletOutput.context↔  
MenuStrip3 [private]
```

CurrentCCD

```
int Umbrella2.Visualizer.WinForms.TrackletOutput.CurrentCCD [private]
```

CurrentImageName

```
string Umbrella2.Visualizer.WinForms.TrackletOutput.CurrentImageName [private]
```

Name of the currently viewed image in its image set.

dataGridView1

```
System.Windows.Forms.DataGridView Umbrella2.Visualizer.WinForms.TrackletOutput.dataGridView1  
[private]
```

dataGridView2

```
System.Windows.Forms.DataGridView Umbrella2.Visualizer.WinForms.TrackletOutput.dataGridView2  
[private]
```

dataGridView3

```
System.Windows.Forms.DataGridView Umbrella2.Visualizer.WinForms.TrackletOutput.dataGridView3  
[private]
```

FieldName

```
string Umbrella2.Visualizer.WinForms.TrackletOutput.FieldName
```

Name of the processed field.

Images

Dictionary<string, [IO.Image](#)> Umbrella2.Visualizer.WinForms.TrackletOutput.Images [private]

Images that can be loaded for viewing.

Used for selecting between differently processed images of the object. It is a cache of the displayed image's image set.

ImageView

[FitsView](#) Umbrella2.Visualizer.WinForms.TrackletOutput.ImageView [private]

ListName

readonly string Umbrella2.Visualizer.WinForms.TrackletOutput.ListName [private]

Name of the list of tracklets.

m_tracklets

List<List<[Tracklet](#)> > Umbrella2.Visualizer.WinForms.TrackletOutput.m_tracklets [private]

ObservatoryCode

string Umbrella2.Visualizer.WinForms.TrackletOutput.ObservatoryCode

MPC Observatory code.

OriginalImageCube

List<IList<[IO.Image](#)> > Umbrella2.Visualizer.WinForms.TrackletOutput.OriginalImageCube [private]

All original input images.

panel1

System.Windows.Forms.Panel Umbrella2.Visualizer.WinForms.TrackletOutput.panel1 [private]

panel2

System.Windows.Forms.Panel Umbrella2.Visualizer.WinForms.TrackletOutput.panel2 [private]

PropertyName1

```
System.Windows.Forms.DataGridViewTextBoxColumn Umbrella2.Visualizer.WinForms.TrackletOutput.↵  
PropertyName1 [private]
```

PropertyName2

```
System.Windows.Forms.DataGridViewTextBoxColumn Umbrella2.Visualizer.WinForms.TrackletOutput.↵  
PropertyName2 [private]
```

PropertyValue1

```
System.Windows.Forms.DataGridViewTextBoxColumn Umbrella2.Visualizer.WinForms.TrackletOutput.↵  
PropertyValue1 [private]
```

PropertyValue2

```
System.Windows.Forms.DataGridViewTextBoxColumn Umbrella2.Visualizer.WinForms.TrackletOutput.↵  
PropertyValue2 [private]
```

ReportFieldName

```
string Umbrella2.Visualizer.WinForms.TrackletOutput.ReportFieldName
```

Name of the processed field as given to the objects in the report.

ReportName

```
string Umbrella2.Visualizer.WinForms.TrackletOutput.ReportName
```

Name of the file to which the report is written.

SelectedDetection

```
ImageDetection Umbrella2.Visualizer.WinForms.TrackletOutput.SelectedDetection [private]
```

SelectedTracklet

```
int Umbrella2.Visualizer.WinForms.TrackletOutput.SelectedTracklet [private]
```

SuspendObjectsUpdate

```
bool Umbrella2.Visualizer.WinForms.TrackletOutput.SuspendObjectsUpdate = false [private]
```

Disable the object number update callback. Used when updating tracklets to prevent the callback from firing while the list mutates.

tabControl1

```
System.Windows.Forms.TabControl Umbrella2.Visualizer.WinForms.TrackletOutput.tabControl1 [private]
```

viewPropertiesToolStripMenuItem

```
System.Windows.Forms.ToolStripMenuItem Umbrella2.Visualizer.WinForms.TrackletOutput.view←  
PropertiesToolStripMenuItem [private]
```

2.205.5 Property Documentation

CurrentTracklets

```
List<Tracklet> Umbrella2.Visualizer.WinForms.TrackletOutput.CurrentTracklets [get], [protected]
```

Displayed tracklets.

2.206 Umbrella2.Visualizers.WinForms.TrackletOutputUtils Class Reference

Static Private Member Functions

- static [EquatorialPoint ComputeBoundingDisk](#) (IEnumerable< [Tracklet](#) > Tracklets, out double Radius)

Static Private Attributes

- const double [RadiusMultiplier](#) = 1.2

2.206.1 Member Function Documentation

ComputeBoundingDisk()

```
static EquatorialPoint Umbrella2.Visualizers.WinForms.TrackletOutputUtils.ComputeBoundingDisk  
(  
    IEnumerable< Tracklet > Tracklets,  
    out double Radius) [static], [private]
```

2.206.2 Member Data Documentation

RadiusMultiplier

```
const double Umbrella2.Visualizers.WinForms.TrackletOutputUtils.RadiusMultiplier = 1.2 [static],  
[private]
```

2.207 Umbrella2.Algorithms.Detection.TrackletsDeduplication Class Reference

Static Public Member Functions

- static void [Deduplicate](#) (List< [Tracklet](#) > Tracklets, double Separation)
In-place deduplicates the list of tracklets at a given detection separation.

Static Private Attributes

- const double [Arc1Sec](#) = Math.PI / 180 / 3600
- const int [MatchOut](#) = 2

2.207.1 Member Function Documentation

Deduplicate()

```
static void Umbrella2.Algorithms.Detection.TrackletsDeduplication.Deduplicate (
    List< Tracklet > Tracklets,
    double Separation) [static]
```

In-place deduplicates the list of tracklets at a given detection separation.

Parameters

<i>Tracklets</i>	Tracklets to deduplicate.
<i>Separation</i>	Separation between 2 detections considered the same. Value in arcseconds.

2.207.2 Member Data Documentation

Arc1Sec

```
const double Umbrella2.Algorithms.Detection.TrackletsDeduplication.Arc1Sec = Math.PI / 180 /
3600 [static], [private]
```

MatchOut

```
const int Umbrella2.Algorithms.Detection.TrackletsDeduplication.MatchOut = 2 [static], [private]
```

2.208 Umbrella2.Pipeline.ExtraIO.Ipef.TrackletStamps Class Reference

List of stamps associated with the tracklet.

Public Attributes

- [StampSet\[\] Sets](#)
Sets of stamps available.

2.208.1 Detailed Description

List of stamps associated with the tracklet.

2.208.2 Member Data Documentation

Sets

`StampSet [] Umbrella2.Pipeline.ExtraIO.Ipef.TrackletStamps.Sets`

Sets of stamps available.

2.209 Umbrella2.TrackletVelocity Class Reference

Represents the velocity of a tracklet.

Public Attributes

- [PixelVelocity PixelVelocity](#)
Represents the velocity in pixel coordinates.
- [EquatorialVelocity EquatorialVelocity](#)
Represents the velocity in equatorial coordinates.
- double [SphericalVelocity](#)
Represents the velocity in radians per second on the sphere.

Properties

- double [ArcSecMin](#) [get]
Equatorial velocity in arcsec per minute.

2.209.1 Detailed Description

Represents the velocity of a tracklet.

2.209.2 Member Data Documentation

EquatorialVelocity

`EquatorialVelocity Umbrella2.TrackletVelocity.EquatorialVelocity`

Represents the velocity in equatorial coordinates.

PixelVelocity

`PixelVelocity Umbrella2.TrackletVelocity.PixelVelocity`

Represents the velocity in pixel coordinates.

SphericalVelocity

`double Umbrella2.TrackletVelocity.SphericalVelocity`

Represents the velocity in radians per second on the sphere.

2.209.3 Property Documentation

ArcSecMin

`double Umbrella2.TrackletVelocity.ArcSecMin [get]`

Equatorial velocity in arcsec per minute.

2.210 Umbrella2.PropertyModel.CommonProperties.TrackletVelocityRegression Class Reference

Represents the correlation coefficient on the regression of tracklet velocity.

Public Attributes

- double [R_TR](#)
Pearson R correlation between Time and RA coordinate.
- double [R_TD](#)
Pearson R correlation between Time and Dec coordinate.
- double [R_RD](#)
Pearson R correlation between X and Y coordinates.
- double [S_TR](#)
Sum of residuals' squares on Time - RA regression.
- double [S_TD](#)
Sum of residuals' squares on Time - Dec regression.
- [LinearRegression.LinearRegressionParameters P_TR](#)
Regression parameters Time - RA.
- [LinearRegression.LinearRegressionParameters P_TD](#)
Regression parameters Time - Dec.
- DateTime [ZeroTime](#)
Time at regression intercept.

2.210.1 Detailed Description

Represents the correlation coefficient on the regression of tracklet velocity.

2.210.2 Member Data Documentation

P_TD

[LinearRegression.LinearRegressionParameters](#) Umbrella2.PropertyModel.CommonProperties.TrackletVelocityRegression.P_TD

Regression parameters Time - Dec.

P_TR

[LinearRegression.LinearRegressionParameters](#) Umbrella2.PropertyModel.CommonProperties.TrackletVelocityRegression.P_TR

Regression parameters Time - RA.

R_RD

double Umbrella2.PropertyModel.CommonProperties.TrackletVelocityRegression.R_RD

Pearson R correlation between X and Y coordinates.

R_TD

double Umbrella2.PropertyModel.CommonProperties.TrackletVelocityRegression.R_TD

Pearson R correlation between Time and Dec coordinate.

R_TR

double Umbrella2.PropertyModel.CommonProperties.TrackletVelocityRegression.R_TR

Pearson R correlation between Time and RA coordinate.

S_TD

double Umbrella2.PropertyModel.CommonProperties.TrackletVelocityRegression.S_TD

Sum of residuals' squares on Time - Dec regression.

S_TR

double Umbrella2.PropertyModel.CommonProperties.TrackletVelocityRegression.S_TR

Sum of residuals' squares on Time - RA regression.

ZeroTime

```
DateTime Umbrella2.PropertyModel.CommonProperties.TrackletVelocityRegression.ZeroTime
```

Time at regression intercept.

2.211 Umbrella2.Pipeline.ExtraIO.Vizier.TsvParameters Struct Reference

Parameters for the [VizieR](#) TSV parser.

Public Attributes

- int [ExpectedFieldCount](#)
Expected number of columns in the TSV result.
- int [RaPos](#)
Column containing the Right Ascension.
- int [DecPos](#)
Column containing the Declination.
- int [MagPos](#)
Column containing the magnitude in the desired band.

2.211.1 Detailed Description

Parameters for the [VizieR](#) TSV parser.

2.211.2 Member Data Documentation

DecPos

```
int Umbrella2.Pipeline.ExtraIO.Vizier.TsvParameters.DecPos
```

Column containing the Declination.

ExpectedFieldCount

```
int Umbrella2.Pipeline.ExtraIO.Vizier.TsvParameters.ExpectedFieldCount
```

Expected number of columns in the TSV result.

MagPos

```
int Umbrella2.Pipeline.ExtraIO.Vizier.TsvParameters.MagPos
```

Column containing the magnitude in the desired band.

RaPos

```
int Umbrella2.Pipeline.ExtraIO.Vizier.TsvParameters.RaPos
```

Column containing the Right Ascension.

2.212 Umbrella2.Pipeline.ExtraIO.Vizier.TsvParser Class Reference

Parser for the TSV output from [VizieR](#).

Public Member Functions

- [TsvParser](#) ([TsvParameters](#) Parameters)
- List< [VizieR.StarInfo](#) > [ParseVizieRResults](#) (string Data)

*Parses the [VizieR](#) data.
Returns*

The list of known stars.

Parameters

Data	Data returned by the VizieR server.
------	---

Public Attributes

- readonly [TsvParameters](#) Params
Parameters used to extract information from the TSV data.

Properties

- string [QueryFormat](#) [get]
Format to request from [VizieR](#) server.

Properties inherited from [Umbrella2.Pipeline.ExtraIO.Vizier.IVizieRParser](#)

2.212.1 Detailed Description

Parser for the TSV output from [VizieR](#).

2.212.2 Constructor & Destructor Documentation

TsvParser()

```
Umbrella2.Pipeline.ExtraIO.Vizier.TsvParser.TsvParser (
    TsvParameters Parameters)
```

2.212.3 Member Function Documentation

ParseVizieRResults()

```
List< VizieR.StarInfo > Umbrella2.Pipeline.ExtraIO.Vizier.TsvParser.ParseVizieRResults (
    string Data)
```

Parses the [VizieR](#) data.

Returns

The list of known stars.

Parameters

<i>Data</i>	Data returned by the VizieR server.
-------------	---

Implements [Umbrella2.Pipeline.ExtraIO.Vizier.IVizierParser](#).

2.212.4 Member Data Documentation

Params

```
readonly TsvParameters Umbrella2.Pipeline.ExtraIO.Vizier.TsvParser.Params
```

Parameters used to extract information from the TSV data.

2.212.5 Property Documentation

QueryFormat

```
string Umbrella2.Pipeline.ExtraIO.Vizier.TsvParser.QueryFormat [get]
```

Format to request from [VizieR](#) server.

Implements [Umbrella2.Pipeline.ExtraIO.Vizier.IVizierParser](#).

2.213 Umbrella2.Pipeline.ExtraIO.Ipef.UmbrellaGroupAttribute Class Reference

Represent a set of data from Umbrella.

Public Member Functions

- [UmbrellaGroupAttribute](#) (string groupName)
Represent a set of data from Umbrella.

Public Member Functions inherited from [Umbrella2.Pipeline.ExtraIO.Ades.GroupAttribute](#)

- [GroupAttribute](#) (string groupName, bool nest)

Additional Inherited Members

Public Attributes inherited from [Umbrella2.Pipeline.ExtraIO.Ades.GroupAttribute](#)

- string [GroupName](#)
Name of the group, as shown in ADES specification.
- bool [Nest](#)
If `true` nest, otherwise flatten the XML hierarchy.

2.213.1 Detailed Description

Represent a set of data from Umbrella.

2.213.2 Constructor & Destructor Documentation

UmbrellaGroupAttribute()

```
Umbrella2.Pipeline.ExtraIO.Ipef.UmbrellaGroupAttribute.UmbrellaGroupAttribute (  
    string groupName)
```

Represent a set of data from Umbrella.

Parameters

<code>groupName</code>	Name of the group as it should appear in the lpef file.
------------------------	---

Returns

The attribute that marks the `class` as a group.

2.214 Umbrella2.IO.UmbrellaIOException Class Reference

Wrapper for [IO](#) exceptions raised from Umbrella.

Public Member Functions

- [UmbrellaIOException](#) (string path, string message)
- [UmbrellaIOException](#) (string path, string message, Exception innerException)

Public Attributes

- string [Path](#)
Path to the resource that raised the exception.

2.214.1 Detailed Description

Wrapper for [IO](#) exceptions raised from Umbrella.

2.214.2 Constructor & Destructor Documentation

UmbrellaIOException() [1/2]

```
Umbrella2.IO.UmbrellaIOException.UmbrellaIOException (  
    string path,  
    string message)
```

UmbrellaIOException() [2/2]

```
Umbrella2.IO.UmbrellaIOException.UmbrellaIOException (  
    string path,  
    string message,  
    Exception innerException)
```

2.214.3 Member Data Documentation

Path

```
string Umbrella2.IO.UmbrellaIOException.Path
```

Path to the resource that raised the exception.

2.215 Umbrella2.IO.FITS.UnsupportedFitsValueException Class Reference

Represents a record that has a value which cannot be handled by the [FITS](#) parsing code.

Public Member Functions

- [UnsupportedFitsValueException](#) (string reason, [MetadataRecord](#) record)
Initializes a new instance of the T:Umbrella2.IO.FITS.UnsupportedFitsValueException class.
- [UnsupportedFitsValueException](#) (string reason, [MetadataRecord](#) record, Exception innerException)
Initializes a new instance of the T:Umbrella2.IO.FITS.UnsupportedFitsValueException class.

Properties

- string [ProblemKeyword](#) [get, private set]
Keyword which triggered this issue. May be null. Note this may not always point to the problem record, as previous records may have put the parsing code in a state where this specific keyword is not valid, although normally it would be fine.

Properties inherited from [Umbrella2.IO.FITS.IFitsParsingError](#)

Static Private Attributes

- const string [MessageFormatString](#) = "{0}, triggered by header record: {1}."

2.215.1 Detailed Description

Represents a record that has a value which cannot be handled by the [FITS](#) parsing code.

2.215.2 Constructor & Destructor Documentation

UnsupportedFitsValueException() [1/2]

```
Umbrella2.IO.FITS.UnsupportedFitsValueException.UnsupportedFitsValueException (
    string reason,
    MetadataRecord record)
```

Initializes a new instance of the T:Umbrella2.IO.FITS.UnsupportedFitsValueException class.

Parameters

<i>reason</i>	Reason why the value is unsupported..
<i>record</i>	Record that caused the exception..

UnsupportedFitsValueException() [2/2]

```
Umbrella2.IO.FITS.UnsupportedFitsValueException.UnsupportedFitsValueException (
    string reason,
    MetadataRecord record,
    Exception innerException)
```

Initializes a new instance of the T:Umbrella2.IO.FITS.UnsupportedFitsValueException class.

Parameters

<i>reason</i>	Reason why the value is unsupported..
<i>record</i>	Record that caused the exception..
<i>innerException</i>	Exception raised in the parsing code.

2.215.3 Member Data Documentation**MessageFormatString**

```
const string Umbrella2.IO.FITS.UnsupportedFitsValueException.MessageFormatString = "{0}, triggered
by header record: {1}." [static], [private]
```

2.215.4 Property Documentation**ProblemKeyword**

```
string Umbrella2.IO.FITS.UnsupportedFitsValueException.ProblemKeyword [get], [private set]
```

Keyword which triggered this issue. May be null. Note this may not always point to the problem record, as previous records may have put the parsing code in a state where this specific keyword is not valid, although normally it would be fine.

Implements [Umbrella2.IO.FITS.IFitsParsingError](#).

2.216 Umbrella2.Algorithms.Filtering.BadzoneFilter.Vector Struct Reference**Static Public Member Functions**

- static double [operator](#) | ([Vector](#) a, [Vector](#) b)

Package Attributes

- double [X](#)
- double [Y](#)

2.216.1 Member Function Documentation**[operator](#)" |()**

```
static double Umbrella2.Algorithms.Filtering.BadzoneFilter.Vector.operator| (
    Vector a,
    Vector b) [static]
```


2.216.2 Member Data Documentation

X

double Umbrella2.Algorithms.Filtering.BadzoneFilter.Vector.X [package]

Y

double Umbrella2.Algorithms.Filtering.BadzoneFilter.Vector.Y [package]

2.217 Umbrella2.Algorithms.Geometry.Vector Struct Reference

2D vector.

Public Member Functions

- void [Increment](#) ([Vector](#) v)
Increments the amount of the current vector by the given vector.
- override string [ToString](#) ()

Static Public Member Functions

- static [Vector operator*](#) (double Scalar, [Vector](#) Vect)
Multiplies the given vector by scalar.

Public Attributes

- double [X](#)
- double [Y](#)

2.217.1 Detailed Description

2D vector.

2.217.2 Member Function Documentation

Increment()

```
void Umbrella2.Algorithms.Geometry.Vector.Increment (  
    Vector v)
```

Increments the amount of the current vector by the given vector.

Parameters

v	Increment amount.
---	-------------------

operator*()

```
static Vector Umbrella2.Algorithms.Geometry.Vector.operator* (  
    double Scalar,  
    Vector Vect) [static]
```

Multiplies the given vector by scalar.

ToString()

```
override string Umbrella2.Algorithms.Geometry.Vector.ToString ()
```

2.217.3 Member Data Documentation

X

```
double Umbrella2.Algorithms.Geometry.Vector.X
```

Y

```
double Umbrella2.Algorithms.Geometry.Vector.Y
```

2.218 Umbrella2.WCS.EquatorialDistance.Vector3D Struct Reference

Represents a 3D vector.

Static Public Member Functions

- static [Vector3D operator+](#) ([Vector3D A](#), [Vector3D B](#))
Vector sum.
- static [Vector3D operator*](#) (double M, [Vector3D B](#))
Product with a scalar.
- static double [operator*](#) ([Vector3D A](#), [Vector3D B](#))
Inner product.

Package Attributes

- double [X](#)
- double [Y](#)
- double [Z](#)

2.218.1 Detailed Description

Represents a 3D vector.

2.218.2 Member Function Documentation

operator*() [1/2]

```
static Vector3D Umbrella2.WCS.EquatorialDistance.Vector3D.operator* (  
    double M,  
    Vector3D B) [static]
```

Product with a scalar.

operator*() [2/2]

```
static double Umbrella2.WCS.EquatorialDistance.Vector3D.operator* (  
    Vector3D A,  
    Vector3D B) [static]
```

Inner product.

operator+()

```
static Vector3D Umbrella2.WCS.EquatorialDistance.Vector3D.operator+ (  
    Vector3D A,  
    Vector3D B) [static]
```

Vector sum.

2.218.3 Member Data Documentation

X

```
double Umbrella2.WCS.EquatorialDistance.Vector3D.X [package]
```

Y

```
double Umbrella2.WCS.EquatorialDistance.Vector3D.Y [package]
```

Z

```
double Umbrella2.WCS.EquatorialDistance.Vector3D.Z [package]
```

2.219 Umbrella2.Pipeline.ExtraIO.VizieR Class Reference

Provides an API for accessing [VizieR](#) services.

Classes

- struct [StarInfo](#)
Star data as provided from [VizieR](#).

Static Public Member Functions

- static List< [StarInfo](#) > [GetVizieRObjects](#) ([EquatorialPoint](#) Center, double Radius, double LowMagLimit)
Retrieves a list of reference stars around a given position.

Static Public Attributes

- static string [VizieRURL](#) = [USNOB10](#)
URL used for querying [VizieR](#).

Static Private Attributes

- const string [USNOB10](#) = "http://vizier.u-strasbg.fr/viz-bin/asu-tsv?-out.max=1000&-sort=_r&-order=l&-oc.↔
form=sexa&-c.eq=J2000&-c.u=arcmin&-c.geom=r&-source=l/284/out&-c="

2.219.1 Detailed Description

Provides an API for accessing [VizieR](#) services.

2.219.2 Member Function Documentation

GetVizieRObjects()

```
static List< StarInfo > Umbrella2.Pipeline.ExtraIO.VizieR.GetVizieRObjects (
    EquatorialPoint Center,
    double Radius,
    double LowMagLimit) [static]
```

Retrieves a list of reference stars around a given position.

Parameters

<i>Center</i>	Location around which to search.
<i>Radius</i>	Radius (in radians) of the search cone.
<i>LowMagLimit</i>	Lowest star magnitude to include in results.

Returns

A list of [StarInfo](#) containing the data of the reference stars.

2.219.3 Member Data Documentation

USNOB10

```
const string Umbrella2.Pipeline.ExtraIO.VizieR.USNOB10 = "http://vizier.u-strasbg.fr/viz-bin/asu-tsv?-out.<->
max=1000&-sort=_r&-order=I&-oc.form=sexa&-c.eq=J2000&-c.u=arcmin&-c.geom=r&-source=I/284/out&-c="
[static], [private]
```

VizieRURL

```
string Umbrella2.Pipeline.ExtraIO.VizieR.VizieRURL = USNOB10 [static]
```

URL used for querying [VizieR](#).

2.220 Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration Class Reference

Provides an algorithm for calibrating image Zero Point using VizieR.

Classes

- struct [CalibrationArgs](#)
Parameters of the calibration algorithm.

Static Public Member Functions

- static double [Calibrate](#) (List< StarInfo > VizieRStars, List< [Star](#) > DetectedStars, double PositionError)
Calibrates an input image using VizieR stars catalogs.
- static double [Calibrate](#) (List< StarInfo > VizieRStars, List< [Star](#) > DetectedStars, double PositionError, out List< Tuple< [Star](#), StarInfo > > Pairs)
Calibrates an input image using VizieR stars catalogs.
- static double [CalibrateImage](#) (Image Img, [CalibrationArgs](#) Args)
Calibrate the zero point of the specified image.
- static double [CalibrateImage](#) (Image Img, [CalibrationArgs](#) Args, out List< Tuple< [Star](#), StarInfo > > CalibrationPairs)
Calibrate the zero point of the specified image.

Static Public Attributes

- static double [CalibMinR](#) = 0.90
Minimum Pearson R for a valid calibration.
- static int [DoubleStarRatio](#) = 5
Maximum ratio to [CalibrationArgs.PositionError](#) at which stars are considered double.

Static Private Attributes

- const double [Arc1Sec](#) = Math.PI / 180 / 3600

2.220.1 Detailed Description

Provides an algorithm for calibrating image Zero Point using VizieR.

2.220.2 Member Function Documentation

Calibrate() [1/2]

```
static double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.Calibrate (
    List< StarInfo > VizieRStars,
    List< Star > DetectedStars,
    double PositionError) [static]
```

Calibrates an input image using VizieR stars catalogs.

Parameters

<i>VizieRStars</i>	List of VizieR stars.
<i>DetectedStars</i>	List of locally detected stars.
<i>PositionError</i>	Maximum position error of stars. Value in arcseconds.

Returns

The Zero Point magnitude.

Calibrate() [2/2]

```
static double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.Calibrate (
    List< StarInfo > VizieRStars,
    List< Star > DetectedStars,
    double PositionError,
    out List< Tuple< Star, StarInfo > > Pairs) [static]
```

Calibrates an input image using VizieR stars catalogs.

Parameters

<i>VizieRStars</i>	List of VizieR stars.
<i>DetectedStars</i>	List of locally detected stars.
<i>PositionError</i>	Maximum position error of stars. Value in arcseconds.
<i>Pairs</i>	Pairs resulting from calibration.

Returns

The Zero Point magnitude.

CalibrateImage() [1/2]

```
static double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrateImage (
    Image Img,
    CalibrationArgs Args) [static]
```

Calibrate the zero point of the specified image.

Returns

The Zero Point magnitude.

Parameters

<i>Img</i>	Image to calibrate.
<i>Args</i>	Calibration parameters.

Returns

The Zero Point magnitude.

CalibrateImage() [2/2]

```
static double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibrateImage (
    Image Img,
    CalibrationArgs Args,
    out List< Tuple< Star, StarInfo > > CalibrationPairs) [static]
```

Calibrate the zero point of the specified image.

Returns

The Zero Point magnitude.

Parameters

<i>Img</i>	Image to calibrate.
<i>Args</i>	Calibration parameters.
<i>CalibrationPairs</i>	Paired local detections and database entries.

Returns

The Zero Point magnitude.

2.220.3 Member Data Documentation**Arc1Sec**

```
const double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.Arc1Sec = Math.PI / 180 / 3600
[static], [private]
```

CalibMinR

```
double Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.CalibMinR = 0.90 [static]
```

Minimum Pearson R for a valid calibration.

DoubleStarRatio

```
int Umbrella2.Pipeline.EIOAlgorithms.VizieRCalibration.DoubleStarRatio = 5 [static]
```

Maximum ratio to [CalibrationArgs.PositionError](#) at which stars are considered double.

2.221 Umbrella2.Pipeline.ExtraIO.VOTableMini Class Reference

Public Member Functions

- [VOTableMini](#) (string TableData)

Public Attributes

- XDocument [doc](#)
- XElement [root](#)
- XElement [votDescription](#)
- List< [Resource](#) > [Resources](#)

Properties

- string [Description](#) [get]

Properties inherited from [Umbrella2.Pipeline.ExtraIO.IVotableContainer](#)

2.221.1 Constructor & Destructor Documentation

VOTableMini()

```
Umbrella2.Pipeline.ExtraIO.VOTableMini.VOTableMini (  
    string TableData)
```

2.221.2 Member Data Documentation

doc

```
XDocument Umbrella2.Pipeline.ExtraIO.VOTableMini.doc
```

Resources

```
List<Resource> Umbrella2.Pipeline.ExtraIO.VOTableMini.Resources
```

root

```
XElement Umbrella2.Pipeline.ExtraIO.VOTableMini.root
```


votDescription

```
XElement Umbrella2.Pipeline.ExtraIO.VOTableMini.votDescription
```

2.221.3 Property Documentation**Description**

```
string Umbrella2.Pipeline.ExtraIO.VOTableMini.Description [get]
```

Implements [Umbrella2.Pipeline.ExtraIO.IVotableContainer](#).

2.222 Umbrella2.Pipeline.ExtraIO.VotableParseException Class Reference**Public Member Functions**

- [VotableParseException](#) (string InnerMessage, System.Type elementType, object Value)

Static Public Member Functions

- static [VotableParseException Create< T >](#) (string Message, T Node)

2.222.1 Constructor & Destructor Documentation**VotableParseException()**

```
Umbrella2.Pipeline.ExtraIO.VotableParseException.VotableParseException (
    string InnerMessage,
    System.Type elementType,
    object Value)
```

2.222.2 Member Function Documentation**Create< T >()**

```
static VotableParseException Umbrella2.Pipeline.ExtraIO.VotableParseException.Create< T > (
    string Message,
    T Node) [static]
```

2.223 Umbrella2.Pipeline.ExtraIO.Vizier.VotableParser Class Reference**Public Member Functions**

- [VotableParser](#) ()
- List< [VizieR.StarInfo](#) > [ParseVizieRResults](#) (string Data)
Parses the [VizieR](#) data.

Properties

- string [QueryFormat](#) [get]
Format to request from [VizieR](#) server.

Properties inherited from [Umbrella2.Pipeline.ExtraIO.Vizier.IVizierParser](#)

2.223.1 Constructor & Destructor Documentation

VotableParser()

```
Umbrella2.Pipeline.ExtraIO.Vizier.VotableParser.VotableParser ()
```

2.223.2 Member Function Documentation

ParseVizierResults()

```
List< VizieR.StarInfo > Umbrella2.Pipeline.ExtraIO.Vizier.VotableParser.ParseVizierResults (
    string Data)
```

Parses the [VizieR](#) data.

Returns

The list of known stars.

Parameters

<i>Data</i>	Data returned by the VizieR server.
-------------	---

Implements [Umbrella2.Pipeline.ExtraIO.Vizier.IVizierParser](#).

2.223.3 Property Documentation

QueryFormat

```
string Umbrella2.Pipeline.ExtraIO.Vizier.VotableParser.QueryFormat [get]
```

Format to request from [VizieR](#) server.

Implements [Umbrella2.Pipeline.ExtraIO.Vizier.IVizierParser](#).

2.224 Umbrella2.WCS.WCSLinPart Class Reference

Computes linear the linear part of the [WCS](#) transforms.

Public Member Functions

- [WCSLinPart](#) (double CDRA_X, double CDRA_Y, double CDDec_X, double CDDec_Y, double RefX, double RefY)
Creates a new instance of [WCSLinPart](#).
- [ProjectionPoint](#) [GetProjectionPoint](#) ([PixelPoint](#) Point)
- [ProjectionPoint\[\]](#) [GetProjectionPoints](#) ([PixelPoint\[\]](#) Points)
- List< [ProjectionPoint](#) > [GetProjectionPoints](#) (IEnumerable< [PixelPoint](#) > Points)
- [PixelPoint](#) [GetPixelPoint](#) ([ProjectionPoint](#) Point)
- [PixelPoint\[\]](#) [GetPixelPoints](#) ([ProjectionPoint\[\]](#) Points)
- List< [PixelPoint](#) > [GetPixelPoints](#) (IEnumerable< [ProjectionPoint](#) > Points)
- [ProjectionVelocity](#) [GetProjectionVelocity](#) ([PixelVelocity](#) PV)
- [PixelVelocity](#) [GetPixelVelocity](#) ([ProjectionVelocity](#) PV)

Public Attributes

- readonly double [WCSChainDerivative](#)
Average scaling from pixel coordinates to projection plane coordinates.

Properties

- double[] [Matrix](#) [get]
The transformation matrix conforming to the FITS standard.

Private Attributes

- readonly double [C11](#)
- readonly double [C12](#)
- readonly double [C21](#)
- readonly double [C22](#)
- readonly double [R11](#)
- readonly double [R12](#)
- readonly double [R21](#)
- readonly double [R22](#)
- readonly double [Ref1](#)
- readonly double [Ref2](#)

2.224.1 Detailed Description

Computes linear the linear part of the [WCS](#) transforms.

2.224.2 Constructor & Destructor Documentation**WCSLinPart()**

```
Umbrella2.WCS.WCSLinPart.WCSLinPart (
    double CDRA_X,
    double CDRA_Y,
    double CDDec_X,
    double CDDec_Y,
    double RefX,
    double RefY)
```

Creates a new instance of [WCSLinPart](#).

Parameters

<i>CDRA_X</i>	X to RA component, in degrees.
<i>CDRA_Y</i>	Y to RA component, in degrees.
<i>CDDec↔_X</i>	X to Dec component, in degrees.
<i>CDDec↔_Y</i>	Y to Dec component, in degrees.
<i>RefX</i>	Reference X point, 1-based.
<i>RefY</i>	Reference Y point, 1-based.

2.224.3 Member Function Documentation

GetPixelPoint()

```
PixelPoint Umbrella2.WCS.WCSLinPart.GetPixelPoint (
    ProjectionPoint Point)
```

GetPixelPoints() [1/2]

```
List< PixelPoint > Umbrella2.WCS.WCSLinPart.GetPixelPoints (
    IEnumerable< ProjectionPoint > Points)
```

GetPixelPoints() [2/2]

```
PixelPoint[] Umbrella2.WCS.WCSLinPart.GetPixelPoints (
    ProjectionPoint[] Points)
```

GetPixelVelocity()

```
PixelVelocity Umbrella2.WCS.WCSLinPart.GetPixelVelocity (
    ProjectionVelocity PV)
```

GetProjectionPoint()

```
ProjectionPoint Umbrella2.WCS.WCSLinPart.GetProjectionPoint (
    PixelPoint Point)
```

GetProjectionPoints() [1/2]

```
List< ProjectionPoint > Umbrella2.WCS.WCSLinPart.GetProjectionPoints (
    IEnumerable< PixelPoint > Points)
```

GetProjectionPoints() [2/2]

```
ProjectionPoint[] Umbrella2.WCS.WCSLinPart.GetProjectionPoints (
    PixelPoint[] Points)
```

GetProjectionVelocity()

```
ProjectionVelocity Umbrella2.WCS.WCSLinPart.GetProjectionVelocity (
    PixelVelocity PV)
```

2.224.4 Member Data Documentation**C11**

```
readonly double Umbrella2.WCS.WCSLinPart.C11 [private]
```

C12

```
readonly double Umbrella2.WCS.WCSLinPart.C12 [private]
```

C21

```
readonly double Umbrella2.WCS.WCSLinPart.C21 [private]
```

C22

```
readonly double Umbrella2.WCS.WCSLinPart.C22 [private]
```

R11

```
readonly double Umbrella2.WCS.WCSLinPart.R11 [private]
```

R12

```
readonly double Umbrella2.WCS.WCSLinPart.R12 [private]
```

R21

```
readonly double Umbrella2.WCS.WCSLinPart.R21 [private]
```

R22

```
readonly double Umbrella2.WCS.WCSLinPart.R22 [private]
```

Ref1

```
readonly double Umbrella2.WCS.WCSLinPart.Ref1 [private]
```

Ref2

```
readonly double Umbrella2.WCS.WCSLinPart.Ref2 [private]
```

WCSCChainDerivative

```
readonly double Umbrella2.WCS.WCSLinPart.WCSCChainDerivative
```

Average scaling from pixel coordinates to projection plane coordinates.

2.224.5 Property Documentation**Matrix**

```
double [ ] Umbrella2.WCS.WCSLinPart.Matrix [get]
```

The transformation matrix conforming to the FITS standard.

2.225 Umbrella2.WCS.Projections.WCSProjections Class Reference

Functions for dealing with [WCS](#) projection algorithms.

Public Member Functions

- void [LoadFromTypeList](#) (Type[] TypeArray)
Loads projection algorithms from a list of dotNET types.

Static Public Member Functions

- static [WCSProjectionTransform](#) [GetProjectionTransform](#) (string Algorithm, double RA, double Dec)
Retrieves the projection algorithm from the list of known projection algorithm.

Protected Member Functions

- [WCSProjections](#) [Register](#) ()
Singleton registration.

Private Attributes

- Dictionary< string, Type > [ProjectionTypes](#) = new Dictionary<string, Type>()

Static Private Attributes

- static [WCSProjections Instance](#) = new [WCSProjections\(\)](#).[Register\(\)](#)
The singleton instance.

2.225.1 Detailed Description

Functions for dealing with [WCS](#) projection algorithms.

2.225.2 Member Function Documentation

GetProjectionTransform()

```
static WCSProjectionTransform Umbrella2.WCS.Projections.WCSProjections.GetProjectionTransform
(
    string Algorithm,
    double RA,
    double Dec) [static]
```

Retrieves the projection algorithm from the list of known projection algorithm.

Parameters

<i>Algorithm</i>	Name of the algorithm
<i>RA</i>	Reference point Right Ascension.
<i>Dec</i>	Reference point Declination.

Returns

An instance of the projection algorithm at given reference point.

LoadFromTypeList()

```
void Umbrella2.WCS.Projections.WCSProjections.LoadFromTypeList (
    Type[] TypeArray)
```

Loads projection algorithms from a list of dotNET types.

Parameters

<i>TypeArray</i>	List of types.
------------------	----------------

Implements [Umbrella2.Plugins.IPluggableElementLoader](#).

Register()

`WCSProjections` Umbrella2.WCS.Projections.WCSProjections.Register () [protected]

Singleton registration.

Returns

The instance.

2.225.3 Member Data Documentation

Instance

`WCSProjections` Umbrella2.WCS.Projections.WCSProjections.Instance = new `WCSProjections`() .Register () [static], [private]

The singleton instance.

ProjectionTypes

`Dictionary<string, Type>` Umbrella2.WCS.Projections.WCSProjections.ProjectionTypes = new `Dictionary<string, Type>`() [private]

2.226 Umbrella2.WCS.WCSProjectionTransform Class Reference

Public Member Functions

- `WCSProjectionTransform` (double `RA`, double `Dec`)
- `EquatorialPoint` `GetEquatorialPoint` (`ProjectionPoint` `Point`)
- `EquatorialPoint[]` `GetEquatorialPoints` (`ProjectionPoint[]` `Points`)
- `List< EquatorialPoint >` `GetEquatorialPoints` (`IEnumerable< ProjectionPoint >` `Points`)
- `ProjectionPoint` `GetProjectionPoint` (`EquatorialPoint` `Point`)
- `ProjectionPoint[]` `GetProjectionPoints` (`EquatorialPoint[]` `Points`)
- `List< ProjectionPoint >` `GetProjectionPoints` (`IEnumerable< EquatorialPoint >` `Points`)
- `EquatorialVelocity` `GetEquatorialVelocity` (`ProjectionVelocity` `PV`)
- `ProjectionVelocity` `GetProjectionVelocity` (`EquatorialVelocity` `EV`)
- double `GetEstimatedWCSCChainDerivative` ()

Estimated linear distance derivative for quick computation of image distances and velocities.

- void `GetReferencePoints` (out double `RA`, out double `Dec`)

Retrieves the coordinates of the reference point of the projection.

Protected Attributes

- readonly double `RA`
Reference point Right Ascension.
- readonly double `Dec`
Reference point Declination.

Properties

- string [Name](#) [get]
Name of the projection algorithm (tag).
- string [Description](#) [get]
Description of the projection algorithm (ex. full algorithm name).

2.226.1 Constructor & Destructor Documentation

WCSProjectionTransform()

```
Umbrella2.WCS.WCSProjectionTransform.WCSProjectionTransform (
    double RA,
    double Dec)
```

2.226.2 Member Function Documentation

GetEquatorialPoint()

```
EquatorialPoint Umbrella2.WCS.WCSProjectionTransform.GetEquatorialPoint (
    ProjectionPoint Point) [abstract]
```

GetEquatorialPoints() [1/2]

```
List< EquatorialPoint > Umbrella2.WCS.WCSProjectionTransform.GetEquatorialPoints (
    IEnumerable< ProjectionPoint > Points) [abstract]
```

GetEquatorialPoints() [2/2]

```
EquatorialPoint[] Umbrella2.WCS.WCSProjectionTransform.GetEquatorialPoints (
    ProjectionPoint[] Points) [abstract]
```

GetEquatorialVelocity()

```
EquatorialVelocity Umbrella2.WCS.WCSProjectionTransform.GetEquatorialVelocity (
    ProjectionVelocity PV) [abstract]
```

GetEstimatedWCSChainDerivative()

```
double Umbrella2.WCS.WCSProjectionTransform.GetEstimatedWCSChainDerivative () [abstract]
```

Estimated linear distance derivative for quick computation of image distances and velocities.

Returns

GetProjectionPoint()

```
ProjectionPoint Umbrella2.WCS.WCSProjectionTransform.GetProjectionPoint (
    EquatorialPoint Point) [abstract]
```

GetProjectionPoints() [1/2]

```
ProjectionPoint[] Umbrella2.WCS.WCSProjectionTransform.GetProjectionPoints (
    EquatorialPoint[] Points) [abstract]
```

GetProjectionPoints() [2/2]

```
List< ProjectionPoint > Umbrella2.WCS.WCSProjectionTransform.GetProjectionPoints (
    IEnumerable< EquatorialPoint > Points) [abstract]
```

GetProjectionVelocity()

```
ProjectionVelocity Umbrella2.WCS.WCSProjectionTransform.GetProjectionVelocity (
    EquatorialVelocity EV) [abstract]
```

GetReferencePoints()

```
void Umbrella2.WCS.WCSProjectionTransform.GetReferencePoints (
    out double RA,
    out double Dec) [abstract]
```

Retrieves the coordinates of the reference point of the projection.

Parameters

<i>RA</i>	Reference point Right Ascension.
<i>Dec</i>	Reference point Declination.

2.226.3 Member Data Documentation**Dec**

```
readonly double Umbrella2.WCS.WCSProjectionTransform.Dec [protected]
```

Reference point Declination.

RA

```
readonly double Umbrella2.WCS.WCSProjectionTransform.RA [protected]
```

Reference point Right Ascension.

2.226.4 Property Documentation

Description

```
string Umbrella2.WCS.WCSProjectionTransform.Description [get], [abstract]
```

Description of the projection algorithm (ex. full algorithm name).

Name

```
string Umbrella2.WCS.WCSProjectionTransform.Name [get], [abstract]
```

Name of the projection algorithm (tag).

2.227 Umbrella2.WCS.WCSViaProjection Class Reference

Represents a transform of FITS image coordinates to [WCS](#) via a linear map and a spherical projection.

Public Member Functions

- [WCSViaProjection](#) ([WCSProjectionTransform](#) Projection, [WCSLinPart](#) Matrix)
- [EquatorialPoint](#) [GetEquatorialPoint](#) ([PixelPoint](#) Point)
- [EquatorialPoint\[\]](#) [GetEquatorialPoints](#) ([PixelPoint\[\]](#) Points)
- List< [EquatorialPoint](#) > [GetEquatorialPoints](#) (IEnumerable< [PixelPoint](#) > Points)
- [PixelPoint](#) [GetPixelPoint](#) ([EquatorialPoint](#) Point)
- [PixelPoint\[\]](#) [GetPixelPoints](#) ([EquatorialPoint\[\]](#) Points)
- List< [PixelPoint](#) > [GetPixelPoints](#) (IEnumerable< [EquatorialPoint](#) > Points)
- double [GetEstimatedWCSChainDerivative](#) ()
- [EquatorialVelocity](#) [GetEquatorialVelocity](#) ([PixelVelocity](#) PV)
- [PixelVelocity](#) [GetPixelVelocity](#) ([EquatorialVelocity](#) EV)

Public Attributes

- readonly [WCSProjectionTransform](#) [ProjectionTransform](#)
- readonly [WCSLinPart](#) [LinearTransform](#)

2.227.1 Detailed Description

Represents a transform of FITS image coordinates to [WCS](#) via a linear map and a spherical projection.

2.227.2 Constructor & Destructor Documentation

WCSViaProjection()

```
Umbrella2.WCS.WCSViaProjection.WCSViaProjection (
    WCSProjectionTransform Projection,
    WCSLinPart Matrix)
```

2.227.3 Member Function Documentation

GetEquatorialPoint()

```
EquatorialPoint Umbrella2.WCS.WCSViaProjection.GetEquatorialPoint (  
    PixelPoint Point)
```

Implements [Umbrella2.WCS.IWCSProjection](#).

GetEquatorialPoints() [1/2]

```
List< EquatorialPoint > Umbrella2.WCS.WCSViaProjection.GetEquatorialPoints (  
    IEnumerable< PixelPoint > Points)
```

Implements [Umbrella2.WCS.IWCSProjection](#).

GetEquatorialPoints() [2/2]

```
EquatorialPoint[] Umbrella2.WCS.WCSViaProjection.GetEquatorialPoints (  
    PixelPoint[] Points)
```

Implements [Umbrella2.WCS.IWCSProjection](#).

GetEquatorialVelocity()

```
EquatorialVelocity Umbrella2.WCS.WCSViaProjection.GetEquatorialVelocity (  
    PixelVelocity PV)
```

Implements [Umbrella2.WCS.IWCSProjection](#).

GetEstimatedWCSChainDerivative()

```
double Umbrella2.WCS.WCSViaProjection.GetEstimatedWCSChainDerivative ()
```

Implements [Umbrella2.WCS.IWCSProjection](#).

GetPixelPoint()

```
PixelPoint Umbrella2.WCS.WCSViaProjection.GetPixelPoint (  
    EquatorialPoint Point)
```

Implements [Umbrella2.WCS.IWCSProjection](#).

GetPixelPoints() [1/2]

```
PixelPoint[] Umbrella2.WCS.WCSViaProjection.GetPixelPoints (  
    EquatorialPoint[] Points)
```

Implements [Umbrella2.WCS.IWCSProjection](#).

GetPixelPoints() [2/2]

```
List< PixelPoint > Umbrella2.WCS.WCSViaProjection.GetPixelPoints (
    IEnumerable< EquatorialPoint > Points)
```

Implements [Umbrella2.WCS.IWCSProjection](#).

GetPixelVelocity()

```
PixelVelocity Umbrella2.WCS.WCSViaProjection.GetPixelVelocity (
    EquatorialVelocity EV)
```

Implements [Umbrella2.WCS.IWCSProjection](#).

2.227.4 Member Data Documentation**LinearTransform**

readonly [WCSLinPart](#) Umbrella2.WCS.WCSViaProjection.LinearTransform

ProjectionTransform

readonly [WCSProjectionTransform](#) Umbrella2.WCS.WCSViaProjection.ProjectionTransform

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