The image processing software Ragview

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1 Overview

Ragview was developed in 1991 at the Institute of Astronomy, to provide tools for analyzing of astronomical images in general, and solar radio spectrograms in particular. It is written in IDL. It provides a set of procedures specific to the analysis and visualization of solar radio spectrograms, as well as a menu interface to facilitate the use of the procedures. It has been tested on Unix Workstations with X-Windows, and made available to external users by the way of the solar software tree. Its main features are:

- Analysis and visualization of images with non-regular axes, for instance solar radio spectrogram images with variable channel separations.
- Handling of large-size images, often with more than 1 million pixels, providing for instance tools to display several image regions using a fixed zoom factor.
- Switching between one- or two-dimensional data representations, for instance to display 1D "cuts" of images.
- Handling of noise and background intensity, for instance to subtract constant or gliding image background.
- Image editing, for instance to eliminate automatically bad channels in spectrograms.

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2 Installation

The Ragview software is available in the solar software tree (SSW) distribution, at

`http://www.lmsal.com/solarsoft/ssw_whatitis.html.`

In the tree, it resides under the path `$SSW/radio/ethz`. To use it, you must either install the ssw on your system or upgrade it if you have already installed ssw.

To install the ssw, follow the instructions given at

`http://www.lmsal.com/solarsoft/ssw_install_howto.html.`

Make sure to select in the installation form

`http://www.lmsal.com/solarsoft/ssw_install.html`

the box "ETHZ", which will include in your site-specific tree the Ragview software branch. Once the installation script is generated, let it run on your system.

To upgrade an existing ssw installation, follow the instructions given at

`http://www.lmsal.com/solarsoft/ssw_upgrades.html.`

In the interactive upgrade, you can load the Ragview software by typing

`ssw_upgrade, /ethz, /spawn.`

Make sure that you have sufficient privilege to execute the operation or contact your local system administrator.

Once the ssw tree is installed, you will have to set the correct SSW environment variables and IDL setup. This is described at

`http://www.lmsal.com/solarsoft/ssw_setup.html.`

Make sure to include the `ETHZ` "instrument" in the list of instruments given by the environment variable `$SSW_INSTR`. You may need to start a new session or source your `.login` or `.cshrc` file to make the changes effective. Finally, type `sswidl` to start IDL under ssw environment and in IDL, type `Ragview` to start the user interface.

3 Structure

The system is composed of a user interface and a number of active procedures. The user interface allows to access the active procedures which perform image or window transformations. In other words, the user interface provides the communication between the active procedures and the user. The system structure is depicted in Figure 1.

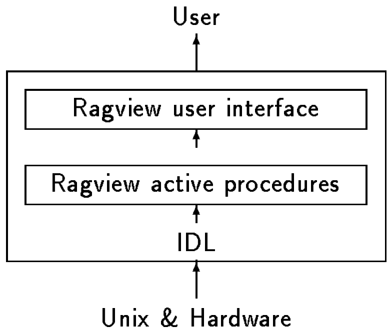

Figure 1: The relation between the Ragview user interface and the active procedures

3.1 User Interface

The User Interface consists of a main level, 5 sub-levels, and an access to the 1D data analysis software Mdisp (described in Section 5).

The elements of the main menu provide access to the sub-levels. The elements of the sub-level menus provide access to the active procedures or to sub-sub-levels (not shown on the figure). Every level is independent, but always handle with the same image. The sub-levels are:

- *File Handling* — To read files from RAG-FITS and ASCII data formats. It reads also files written in the obsolete data formats SCA or SB4. It allows to write files in the RAG-FITS data format and in ASCII.

- *Modify* — To modify pixel values. Operations provided are for instance smoothing, exponentiation, interpolation or Fourier transformation. Editing functions are implemented as well as background handling facilities. Some operations are applied to all pixels of the image, like smoothing. Other operations are applied only to a specific part of the image, such as Fourier transformation.

- *Display* — Allows to change the way an image is displayed, without modifying the pixel values. Operations provided are, for instance, zooming, color table handling, printing, reading single pixel values. Zooming and color table handling involve sub-level menus:

  - *Zooming* — Can be done either in x-, or y-, or in both directions. The zoom factor is set either interactively (with the mouse) or statically (with input from the keyboard). Furthermore, a zoom called *Full Resolution Around Cursor* zooms the image around the cursor such that every image pixel is displayed on the IDL window.

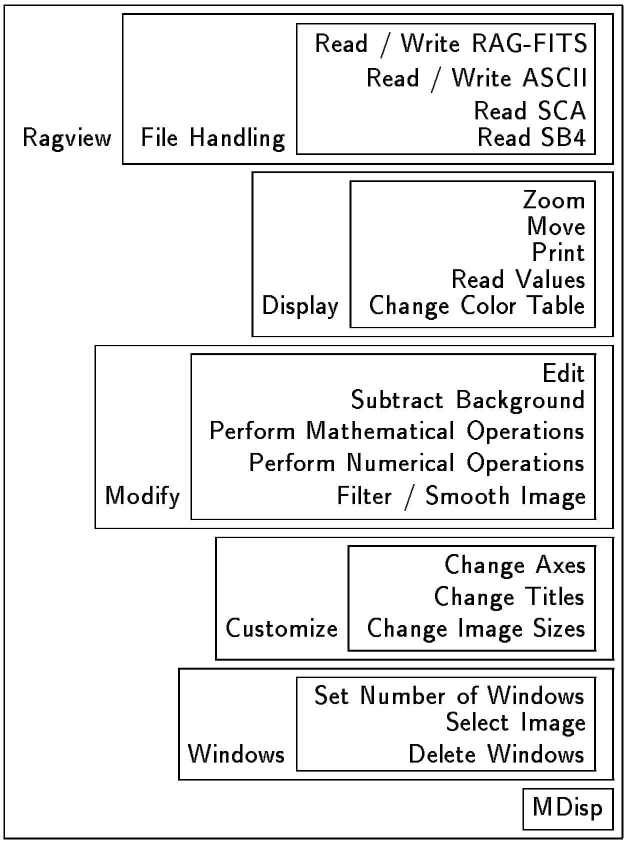

Figure 2: The structure of the Ragview user interface. It provides access to 5 sub-levels and to the 1D data analysis software Mdisp.

  - *Color Table Handling* — Provides access to many options from IDL like selection of a color table from 32 predefined, changes on a color table, save user-defined tables on file or restore them from files.

- *Customize* — To change the default values for titles, axis definitions, or for the format of the page to be printed. Sub-level menus are used to access the following topics:

  - *Axis Definition Modification* — To set for both the x- and the y-axis new minimum, maximum and step values.
  - *Title Modification* — To change the main title of the image, as well as the x- and the y-axis annotations.
  - *Display Modification* — To change the position of the image on the window, its width, its height, as well as the size of the window.
  - *Paper Format Modification* — Allows to change the default value of the width, the height, orientation, etc. of the image when printed on paper. The document can be saved in an encapsulated Postscript file or printed it on a single sheet of paper.

- *Access to Mdisp* — To access Mdisp, the 1D data analysis package bundled with Ragview. From a user-selected part of the image, a set of x- or y-profiles are transmitted to Mdisp. The program creates either $< x, z >$-tuples or $< y, z >$-tuples from the $< x, y, z >$-tuples corresponding to image pixels.

- *Window and Selection Management* — To modify the number of images displayed simultaneously. Up to 16 windows can be used. In this way modifications, zooms, move operations, can be displayed in separate windows. Once the selected number of windows is reached, the window opened first is replaced.

The selection management allows also to re-load previously displayed images. Images read from files are stored *permanently*, that is, they are available during the whole Ragview session. Images that have been modified are stored *temporarily*, that is, they are available only until a number of further modifications have been done or new images have been loaded. The number of temporary images can be specified.

4 Active Procedures

A detailed description of the active procedures is given in the list of procedures at `http://www.astro.phys.ethz.ch/rag/software/pro-list.html`. This overview lists the procedures classified by sub-levels in which they are called from. Procedures with a " †" after their names are IDL standard. The others are specific to Ragview. You can get more information about single procedures using the RAG IDL on-line help at `http://helene.ethz.ch/rag/help/idl-man.html`, or by using in idl the procedure `xdoc`.

4.1 File Handling Procedures

Reads an image from a file or write an image to a file. Currently, only the RAG-FITS documentation is available at

`http://www.astro.phys.ethz.ch/rag/help/ragfits-format.ps.`

Documentation on other file formats will be available shortly, although it should be noted that they are obsolete formats, except the ASCII format.

1. `RAGFitsRead`
2. `RAGFitsWrite`
3. `ASCII_Read`
4. `ASCII_Write`
5. `Fortran_Read`
6. `SB4_Read`
7. `SCA_Read`

The first word of the procedure name corresponds to the file format.

4.2 Modify Procedures

Perform modification of pixel values. Many operations are provided. This includes the following operations:

1. Exponentiation `Exp` †
2. Logarithm `Log` †
3. Fourier transformation `FFT`†
4. Backward Fourier transformation `FFT` †
5. Autocorrelation `AutoCorr`
6. Set minimum/maximum value `SetMinMax`
7. Cut least/highest value `CutMinMax`
8. `Smooth` †

9. `ConstBackSub`, for constant background subtraction
10. Gliding background `GlidBackSub`,
11. Minimum envelope subtraction `MinEnvBack`
12. Two-dimensional integration `Integrate_2D`
13. Editing functions `Edit`
14. Eliminate wrong channels: `ElimWrongChannels`

4.3 Display Procedures

Perform display operations

1. `Show_Image` displays an image; it can display the x-axis with time and both x- and y-axes with non-regular values.
2. `TV_Zoom`
3. `Pixel_Read`
4. `Move_Image`
5. Quick zoom `Zoom` †

4.3.1 Color Table Handling Procedures

Handle color tables:

1. Reads a predefined color table: `LoadCT` †
2. Reads a user defined color table from a file: `Load_User_CT`
3. Saves a user-defined color table in a file: `Save_User_CT`
4. Modifies a color value or a set of values: `Palette` †
5. Adjusts a color value `AdjCT` †
6. Histogram equalizes the color table `Hist_Equal_CT` †
7. Stretches the color table: `Stretch` †

4.4 Custom Procedure

Used to set new values and titles for axes, new image title, set new dimensions of windows and images. This is done via the procedure `Customize_2D`

4.5 Access to Mdisp

The access is done via the procedure `Ragview_Mdisp_Int`. The latter converts x-vectors or y-vectors from the image into plots (profiles) readable by the Mdisp system. The user has the possibility to choose the direction of the vectors, namely "x" or "y".

5 Mdisp

Mdisp is a data analysis software for 1D plots. It is foreseen to work together with Ragview, althoug it can also be used independently. Mdisp is bundled with Ragview, that is, no installation is required when Ragview is installed.

Mdisp does for one-dimensional data, called *plots*, what Ragview does for images (two-dimensional data). A one-dimensional data set is defined as a set of tuples $< x, y >$.

Mdisp allows to display several plots simultaneously. The user can select through the Selectioner, which plot he or she wants to display, from a "pool" of plots. This pool contains plots that have been either read from files, transfered from Ragview or created by modifying other plots.

5.1 Structure of Mdisp

Mdisp is structured in the same way as Ragview, (see Section 1). The program consists of a main level, and five sub-levels, which allow to navigate between the different parts of the system and access procedures that display or modify the data. Its structure is schematized in Figure 3. The sub-levels are:

- *The File Handler* — To read and write files. The system reads or writes two one-dimensional data formats, *mdisp* and *cols* files. These names are also the extensions of the file names. Both formats are in ASCII, an contain either a header followed by the data, or the data alone. The data is ordered in columns and lines. The file format description will be available soon.

- *The Displayer* — To display data, zoom, read single values. The displayer is useful to *zoom* into a given range in x and/or in y direction, to reset zoom factors, to *read* values or to *integrate* (i.e. compute the surface between a given plot and the x-axis.

- *The Modifyer* — To fit functions, edit data points, apply mathematical functions. The modifyer changes the values of the data, while it does not change the layout of the display. It has a number of sublevels:

  - *Simple Mathematical Functions* — To select a function to apply on the data.

  - *General Mathematical Functions* — To access functions such as autocorrelation, Fourier transformation, derivation.
  - *Edit* — To extract a subplot another plot.
  - *Smooth and Fit* — To fit a curve using several methods: polynomial, gauss, etc.

- *The Customizer* — To change titles, display formats, axis notations. The customizer has two sublevels:
  - *Plot Attributes* — To change the titles, plot symbol, line thickness associated with an individual plot.
  - *Display Attributes* — To change the titles displayed in the window. Also, tick labels can be redefined.
  - *Texts to Overplot* — To print text on a plot at a specific location.

- *Selectioner* — Allows to select which plots from the pool of plots actually have to be displayed. During an Mdisp session, one works on a *selection* of plots from the pool of available plots.

A plot belongs to the pool it has been read by the file handler, transmitted from Ragview, or produced by a modification of a plot from the pool. A plot belongs to the selection if it will be displayed on screen in the next display operation.

The selection of plots can be changed by the user in the selectioner The selection of plots is also automatically changed when a plot is modified, when the output of an operation replaces its input. For instance exponentiating the values of a plot will result in selectioning the (newly generated) exponentiated plot and deselcting the original plot.

5.2 MDisp Active Procedures

Active procedures can be called independently of the user interface. The active procedures are categorized in five groups: display, analyse, file handling, custom and selection. Below, only the main procedures are mentioned. The ones with a † are standard IDL procedures. More

5.2.1 Display Procedures

Allow the handling of the data display on the screen.

`Data_Display` plots data.

`Integration` computes the surface under a plot (based on `Poly_Area`†).

`PS_Create_1D` writes plots in PostScript files.

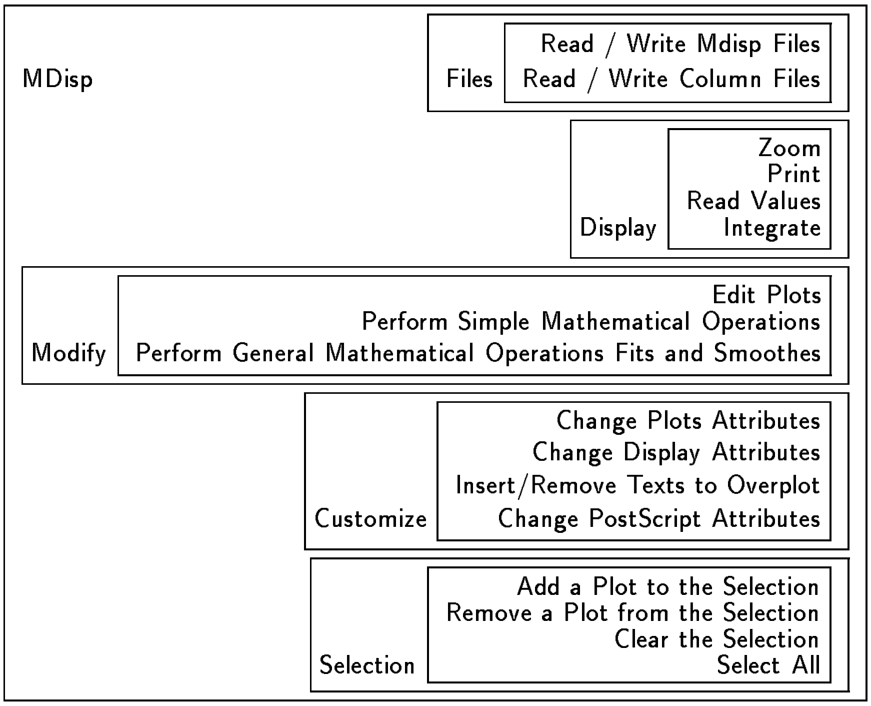

Figure 3: The structure of Mdisp. Each text in a block represents a menu item.

`Read_Values` reads individual plot points on the screen (realized with the procedure `Cursor`†).

`Zoom_1D` zooms into the plot window;

`LoadUserSym` loads one of the following symbols: X, Y, Z, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

5.2.2 Modify Procedures

Performs basic operations on the data (y-axis) or its range (x-axis) selected. The operations are generally accessed via the user interface, because they depend on the display.

`Modify_1d` The modification user interface;

`Fitting` Fits functions to the data.

Most procedures are already in IDL standard, such as FFT, Deriv, Exp, and ALog.

5.2.3 File Handling Procedures

File handling procedures are used to read and write files in specific formats. (The format definitions will be available soon).

`Columns_Read` reads a file containing a given number of columns lines.

`Mdisp_Read` reads a file specific to Mdisp that allows to produce quickly ready-to-print output.

Files in 2D formats like `SCA`, `SB4` or `FITS` are read in Ragview (see Section 1) and transfered to the 1D system.

5.2.4 Customize Procedures

Customize procedures allow mainly mainly access the system variables to store the specified values.

`Customize_1D` The customize user interface.

`OverallDisplay` To modify titles, tick marks, linestyle, etc.

`Overplot_Texts` To interactively include texts into the plot window.

5.2.5 Selection Procedures

Selection procedures are used to store and access the pool of plots in the main memory and to select the plots to be displayed or changed.

`GetNames` Loads the names of the plots selected or in the plot table;

`Init_Data` Initializes the data selection. It must be run before the other procedures. It initializes the *Plot Table* and the *Selection List*.

`InitSel` Initializes the plot selection list.

`InsertPlot` Inserts a plot in the plot table.

`InsertSel` Inserts a plot in the selection list.

`LoadPlot` Loads a plot from the plot table.

`LoadSelection` Loads the plots selectioned.

`N_PlotList()` Returns the number of plots stored in the plot table.

`N_Selected()` Returns the number of plots selected.

`RemoveSel` Removes a plot from the selection list.

`SelectAll` Selects all plots of the plot table;

`Selection` Returns the names of the selected plots.