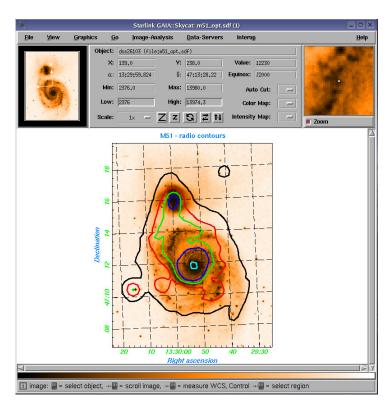Peter W. Draper, Norman Gray, David S. Berry & Mark Taylor

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GAIA – Graphical Astronomy and Image Analysis Tool
4.4-9
User's Manual

Abstract

GAIA is an image and data-cube display and analysis tool for astronomy. It provides the usual facilities of image display tools, plus more astronomically useful ones such as aperture & optimal photometry, contouring, source detection, surface photometry, arbitrary region analysis, celestial coordinate readout, calibration and modification, grid overlays, blink comparison, defect patching and the ability to query on-line catalogues and image servers. It can also display slices from data-cubes, extract and visualise spectra as well as perform full 3D rendering.

Contents

1   Introduction

GAIA is an highly interactive image display tool but with the additional capability of being extendable to integrate other programs and to manipulate and display data-cubes. At present image analysis extensions are provided that cover the astronomically interesting areas of aperture & optimal photometry, automatic source detection, surface photometry, contouring, arbitrary region analysis, celestial coordinate readout, calibration and modification, grid overlays, blink comparison, image defect patching, polarization vector plotting and the ability to connect to resources available in Virtual Observatory catalogues and image archives, as well as the older `Skycat` formats.

GAIA also features tools for interactively displaying image planes from data-cubes and plotting spectra extracted from the third dimension. It can also display 3D visualisations of data-cubes using iso-surfaces and volume rendering.

Specialised handling of data from the CUPID package provides the visualisation of clumps of emission in 2D and 3D, as ellipses, polygons and boxes.

Interoperability with other SAMP enabled applications is provided so that GAIA can be used as part of a integrated desktop (usually querying the Virtual Observatory).

GAIA is a derivative of the SkyCat[1] image display and catalogue browsing tool, developed as part of the VLT[2] project at ESO[3]. Both SkyCat and GAIA are free software under the terms of the GNU copyright.

The 3D facilities in GAIA use the VTK library.

2   Getting Started

The following two sections describe the absolute basics of how to startup GAIA and how to display images using it.

If you need help beyond this, and are new to GAIA, then you should probably read the 'The GAIA CookBook' (SC/17). In addition to the usual introductory text this also contains several recipes for achieving specific tasks (such as measuring instrumental magnitudes and making use of celestial coordinate information, although at the time of writing the astrometric calibration sections are now out of date with the arrival of the new toolboxes based on AUTOASTROM).

The other main source of information about GAIA is the on-line help system. This can be accessed after starting GAIA (just select the `Help` menus). Many windows also feature 'short help'. This is a retangular region at the bottom of a window that may display a one-line description of the window element under the cursor (an approximation of balloon help).

If you need help beyond what is available in these resources, or have any suggestions for improvements, then join the Starlink user support mailing lists at

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[1]http://archive.eso.org/skycat/
[2]http://www.eso.org/vlt/
[3]http://www.eso.org/

```
http://www.starlink.ac.uk
```

The GAIA home page is at:

```
http://www.starlink.ac.uk/gaia/
```

which may be updated from time-to-time. GAIA is available for download as part of JAC Starlink Release at:

```
http://starlink.eao.hawaii.edu
```

2.1 Using GAIA from the C-shell

To display an image in GAIA use the following command (assuming that you are already initialized to use Starlink software):

```
% gaia image_name
```

Alternatively you can use the File menu to load an image.

If you want to display an image in an existing GAIA then use the invocation:

```
% gaiadisp image_name
```

You can also write to a specific window using the clone number:

```
% gaiadisp image_name 2
```

This displays into the window with title GAIA::SkyCat (2). If this window doesn't exist it will be created.

A list of images can be displayed in GAIA using the command:

```
% gaiadisp image_name1 image_name2 image_name3 ...
```

These will be displayed in separate clones. Finally percentile or data cuts can be applied using the -p option or -l and -h options:

```
% gaiadisp -p 98 image_name1 image_name2 image_name3 ...

% gaiadisp -l 100 -h 200 image_name1 image_name2 image_name3 ...
```

(works for the single image case too).

3   What does it actually do?

The capabilities of GAIA fall roughly into three areas; those of an image and cube display tool, those provided for the analysis of images and cubes amd those for querying on-line resources (images and catalogue data held in the VO and other places). Each of these areas is described very briefly in the next sections. As with most graphical tools, probably the best way to find out about GAIA is to explore it interactively. Failing that many windows have a one-page description in the on-line help system and most graphical elements (*buttons, entry fields etc.*) have one-line descriptions that appear in the short-help region at the bottom of windows.

Windows that provide a limited range of controls for some kind of focussed task are called 'toolboxes'. In general what they do should be obvious or they are really front-ends for other software packages. Good examples of this latter type are the photometry and object detection toolboxes. When such a toolbox is used the documentation for the command-line tools is the primary source for finding out what is going on under the bonnet.

3.1   Image display capabilities

GAIA provides the following normal "image display tool" features:

- Display of images in FITS and Starlink NDF formats (this also means that it will display many other data formats using the on-the-fly data conversion ability of the NDF library, most notably the IRAF data format).

- Panning, zooming, data range and colour table manipulations.

- Continuous display of the cursor position and the image data value.

- Display of many images (clones), each in its own window.

- Coloured annotation, using text and line graphics (boxes, circles, polygons, lines with arrowheads, ellipses …).

- Printing of the displayed image and annotations (annotations are drawn using printer resolution, *i.e.* not a screen dump) to a postscript file.

- Real time pixel value table. A table displaying the data values and simple statistics of a region about the cursor can be displayed.

- Display of image planes and spectra from data cubes. Using this you can step along an axis and display the image formed by the other two axes. You can also combine a range of image planes or do the stepping using a timed animation. The displayed images created by this tool can be analysed in the image-analysis toolboxes. A spectrum from the hidden dimension of the cube can be displayed and updated interactively and even sent to the Starlink SPLAT-VO program for analysis and additional inspection. Finally the spectral coordinates can be interactively transformed between various wavelength, frequency, energy and velocity systems.

- Selection of 2D or 3D regions using an integer mask. If you have a mask that segments your image into regions based on some integer value you can view only those parts of your image that correspond to some given values. Such masks are produced by the EXTRACTOR/SExtractor and CUPID applications.

- Histograms of the pixel distribution in rectangular regions of the displayed image. This also shows parabolic and gaussian fits to the distribution (mainly for background estimation), as well as allowing the comparison of two regions.

3.2 Image analysis capabilities

GAIA provides the following features, which are specifically aimed at astronomical work with images:

- Aperture & optimal photometry. A highly interactive environment for controlling the positions, sizes and orientations of circular and elliptical apertures. The sky estimates can be made from annuli of these apertures or from related sky apertures. The measurements can be in either instrumental magnitudes or mean counts (based on the PHOTOM - SUN/45 - program AUTOPHOTOM)

- Automatic source detection. This feature provides the ability to automatically detect and parameterise all the objects on an image. These objects are then identified by displaying ellipses over the image and are available for interactive inspection. The resultant measurements are displayed in a catalogue window which can be used to inspect the individual values, select data on the bases of range limits and change the appearance of the ellipses. This is based on the EXTRACTOR (SUN/226) package, a derivative of SExtractor.

- Extended surface photometry. This allows the interactive identification of extended objects (galaxies) and profile measurements using ellipse fitting. The resultant fits are shown over the images and the measurements can be inspected (based on the ESP - SUN/180 - programs ELLPRO and ELLFOU).

- Image patching. This provides the ability to select arbitrary shaped regions on an image and replace them with a surface fit to other regions, together with an artificial noise component. An ideal way to remove unwanted defects from an image for cosmetic reasons.

- Interactive ARD (SUN/183) regions. This allows the calculation of statistics, the masking out and extraction of arbitrary shaped parts of your images as well defining ARD regions for other programs to use.

- Contouring. This allows the contouring of the displayed image, or the overlay of contours derived from other images. The images are aligned using sky coordinates, if available. Control over individual line colours and thicknesses is provided.

- Polarization vector plotting and manipulation. This provides the ability to display vector maps produced by the POLPACK (SUN/223) package. It also allows you to select sub-sets of vectors, either by algebraic expressions or by rectangular regions. Selected parts can be removed or saved to new catalogues. New vector maps can be created by binning vectors and reports of the properties of selections can be displayed.

- Blink comparison. All the displayed images can be animated (as quickly as your hardware/CPU combination allow), or you can cycle through them by hand.

- Interactive position marking: Mark and label positions on your images and print or record them for future reference. This also allows positions to be read in from text files and input sky coordinates to be transformed to different celestial coordinate systems. Mean seeing and shape parameters of any marked stars are also available as part of this analysis.

- Celestial coordinates readout. If your data have suitable astrometric calibration data available (in recognised headers *i.e.* FITS/IRAF or NDF WCS) then a continuous readout of the current RA and Dec is provided.

- Astrometric calibration. You can either fit a new astrometric calibration to your image (using semi-automated matching between detected images and on-line catalogues or you can define your own reference positions), set one using known information (such the image scale and a reference point), copy one from another image and finally tweak one to make it fit better.

- Astrometric grid overlay. If you can read out sky coordinates then you can also plot a grid overlay with labelled axes. The grid facility is provided with an enormous range of customization options, such as being able to change the celestial coordinate system (from say FK5 to Galactic *etc.*).

- Celestial coordinate system control. You can change the celestial coordinate system used by your image to a new one (to/from FK5, FK4, Ecliptic, Geocentric apparent, Galactic and SuperGalactic).

- Sky coordinate offsets. This feature also relies on being able to read celestial coordinates, if so then you can determine the distance and offsets between any two points on your image (in arc minutes).

- Real time profiling. Two separate toolboxes allow you to either move a line around on the image and see the image data values displayed as a profile change (this profile can also be saved as a spectrum), or do the same with a rectangle, in which case the mean profiles along the X and Y directions are shown.

- Object parameterization. This allows you to select a single object on the image. Details such as its full width half maximum, peak intensity *etc.* will be shown. These values are based on a 2D gaussian fit.

- STC-S regions. IVOA STC-S region outlines (often used to define footprints of various kinds) can be drawn.

- MOC regions. IVOA Multi-Order Coverage region outlines (used to define arbitrary regions of sky using HEALpix tessellations) can be drawn when loaded from suitable FITS tables. MOCs can also be created from Interactive ARD regions.

3.3   On-line catalogue capabilities

Using the facilities provided by SkyCat, GAIA is capable of downloading images from several surveys and catalogues from a wide range of sources, so for instance if your image has a world

coordinate system associated with it, you can query the ESO catalogue of HST guide stars about any located within the bounds of your image. These will then be listed and plotted over your image. Similarly you can query the NED[4] (NASA/IPAC Extragalactic Database) and SIMBAD[5] databases and see lists of all the objects that they know about on your image. You can also display an image returned directly from the Digital Sky Survey[6](and then perform queries in other catalogues about this field). Named objects from certain catalogues can have their full information displayed in a web browser and may even have bibliography links to the ADS[7] abstract service. Finally the HST[8] archives are also available. Using these you can see what observations have been made of any objects on your image (and preview any generally available).

More recently GAIA has been extended to offer similar features, catalogue and image access, using the developing Virtual Observatory. These like the features above are found in the `Data-Servers` menu of the main window.

Note: you should take time to find what your obligations, in terms of the correct acknowledgement of copyright, use of service *etc.* are, whenever you use facilities such as those mentioned above.

3.4 Local catalogues

GAIA allows you to save remote catalogue queries to a local file. These can then be re-loaded and plotted as if on-line catalogues. This is very useful if you need to re-plot catalogues, but equally useful is the fact that local catalogues may be modified. So you can edit, sort, select and delete records (using a tool like TOPCAT[9] or a simple editor if the facilities GAIA offers are not sufficient).

3.4.1 Catalogue formats

Local catalogues may be stored in several formats. The "native" version is called a "tab separated table" (TST). This is a simple text file in which the values of the various fields are separated by a single <TAB> character and the catalogue headers are separated from these by a dashed line:

```
#   comment
keyword1: value1
keyword2: value2


...
ID   <TAB>   RA      <TAB>   DEC   <TAB>   MAG      ...
--           --              ---           ---
OBJ1 <TAB>   210.00 <TAB>    54.00 <TAB>   16.1
OBJ2 <TAB>   210.01 <TAB>    54.01 <TAB>   15.1
....
```

---

[4]http://nedwww.ipac.caltech.edu
[5]http://simbad.u-strasbg.fr/simbad
[6]http://arch-http.hq.eso.org/dss/dss
[7]http://adswww.harvard.edu
[8]http://cadcwww.dao.nrc.ca/hst
[9]http://www.starlink.ac.uk/topcat

The usual format of a catalogue is as above, *i.e.* an object identifier followed by an RA and DEC (in J2000 decimal degrees). Note the `<TAB>` strings shouldn't be typed in, they are shown explicitly just to make clear where they should be placed. The TST format is also recognised by the TOPCAT and CURSA packages (SUN/190). CURSA also contains a description of this format.

Additional formats that can be also read and written by GAIA (with a performance penalty) are those supported by the CURSA package (*i.e.* FITS-tables and STL format) and the "ASCII_HEAD" format of the SExtractor/EXTRACTOR package (SUN/226), as well as the XML VOTable[10] format.

The format that is used to open or write a catalogue, is determined by the file extension:

- **FITS tables**, accepted file types: `.FIT .fit .FITS .fits .GSC .gsc`

- **STL**, accepted file types: `.TXT .txt`

- **ASCII_HEAD**, accepted file types: `.asc .ASC .lis .LIS`

- **VOTable**, accepted file types: `.xml .XML .vot .VOT`

All other file extensions are assumed to indicate a TST (the preferred extensions for these are `.tab` or `.TAB`).

3.4.2   Using your own local catalogues

If you have a simple text file containing columns of positions then the most straight-forward way to plot them in GAIA is by using the 'Select Positions...' toolbox. This accepts (as do the various astrometry toolboxes) a file containing the following values:

```
ID  RA  DEC  X  Y
```

in that order, *e.g.*

```
1    00:19:49.47    00:07:25.9    854     50
2    00:20:06.71    00:06:05.3    240    244
3    00:19:47.54    00:04:23.2    925    484
4    00:19:58.07    00:04:49.1    549    424
5    00:19:48.69    00:06:59.0    882    114
```

The columns should be space separated and the celestial coordinates should be in decimal degrees, or sexagesimal format as shown above. More complex files can be imported into this toolbox using its 'Import text file...' option (this allows fixed column widths or other separators). If you need to import such a file into a catalogue window, (this is the sort of window that queries to on-line catalogues are shown in, and provide extra facilities like applying intensity cuts etc.) then use the `Import plain text file...` toolbox from the `Positions...` menu.

You can also create your own local catalogues in TST format. This allows you to describe how to plot the catalogue. For instance if you wanted to plot position vectors as correctly orientated lines over an image you would need a tab table that contained the following sort of information (again note that the `<TAB>` string should be replace by a single tab character):

---

[10]http://www.ivoa.net/cgi-bin/twiki/bin/view/IVOA/IvoaVOTable

```
# File created by: pwd on June 15, 1999 at 10:24:04
id_col: 0
x_col: 1
y_col: 2
symbol: {ID LENGTH ANGLE} {line {} {} {$ANGLE+27.0} {} {}} {{$LENGTH*0.1} {}}
#
ID <TAB>    XPOS    <TAB> YPOS     <TAB> LENGTH    <TAB>  ANGLE
--          ----          ---            ------           -----
ID#1 <TAB>  206.000 <TAB> 189.000 <TAB> 6.32528  <TAB>   104.816
ID#2 <TAB>  209.000 <TAB> 189.000 <TAB> 5.86891  <TAB>   109.238
```

The `x_col` and `y_col` parameters indicate the columns of the data that correspond to the X and Y positions and the symbol parameter how to plot a line centered on that position. In this case the statements says extract values for the `ID`, `LENGTH` and `ANGLE` columns, then draw lines with position angle `ANGLE+27` and length `LENGTH*0.1` pixels. Note that a dollar sign is used to prefix column names in these expressions (in fact these expressions will be parsed by the Tcl "expr" command, with the column values set to a variable with the same name as the column for each line in the table).

Creating such a symbol parameter is best done by using the special `Set Plot Symbols...` window, available under the local catalogue menu `Options`. Using this window you can plot multiple symbols per object, specify which column to use as labels, change the graphic colour *etc.*. Now if you look in the file `~/.skycat/skycat.cfg` after setting up your options a suitable symbol parameter is recorded together which the description for your local catalogue (which you can then edit into your tab files).

To find out more about the TST format and how to configure plot symbols you should consult the ESO document 'Astronomical Catalog Library'[11] and 'Writing Catalogue and Image Servers for GAIA and CURSA ' (SSN/75).

3.4.3 FITS tables

Much of the above also applies to FITS tables that GAIA will read, *i.e.* FITS keywords with the name `SYMBOL` will be interpreted correctly. Special parameter names that are longer than 8 characters (such as `search_cols`, `sort_order`, `show_cols` and `copyright`) should be truncated. Long symbol expressions can span more than one card by using the names: `SYMBOL1` through `SYMBOL9`. The columns used for world coordinates should have units of degrees or radians and have names like `RA` and `DEC`.

3.5 CUPID catalogues and masks

Catalogues produced by the CUPID application can be displayed in 2D or 3D and it's masks can be displayed or used to view regions.

To display a 2D catalogue just open it as a local catalogue or import it using the `Import CUPID catalogue...` toolbox in the `Image-Analysis positions` menu. This latter option allows you to select which columns to use as RA and Dec and whether to use the special `Shape` column as the plotting symbol (STC-S ellipses and polygons are supported). If you choose not to use the STC-S shapes then boxes based on the extents will be displayed.

---

[11]http://astro.dur.ac.uk/ pdraper/gaia/docs/cat.ps.gz

Displaying 3D catalogues should be done by importing them using the cube toolbox (`View Import CUPID catalogue`). When imported this way only regions that are in the current slice will be displayed. Note that if opened as a 2D catalogue all the regions will be displayed. 3D catalogues can also be viewed in a 3D scene as prisms, just select one of the 3D renderers in the `View` menu in the cube toolbox and click on the `CUPID` tab and select `Display catalogues:`. You can restrict the regions displayed to rows selected in the associated catalogue window by selecting `Only show selected rows:`.

To use a 2D mask open it using the `Mask image...` toolbox in the `Image-Analysis` menu. This can then be applied to the displayed image and individual or ranges of regions can be selected for display.

To use a 3D mask look in the CUPID tab in the 3D rendering window and select your mask in the `Mask:` entry. To just display the mask select `Display:` and press `Draw`. To view individual regions or a range enter some values into `Values:`. To apply these regions to the main cube and select the original flux you need to select `Apply mask:` and probably select `Display:` of the mask itself (although you can display both together, in that case you may want to change the opacity).

3.6   Accessing images of differing formats

GAIA can display and perform analyses on many different data formats. It does this by using the "on-the-fly" conversion facilities of the NDF library, which it uses directly. This on-the-fly conversion uses external programs that can convert your data from its current format into an NDF and then back again (if necessary).

The CONVERT (SUN/55) package provides many formats that are useful for astronomers (*e.g.* FITS, IRAF and old FIGARO formats) and is automatically used by GAIA (unless you have set up your own conversion facilities, see SSN/20 if you think you need to do this). All the formats recognised at any time by GAIA are shown in a menu in the file chooser, so check this to see if your format is available.

FITS files are a special case in that GAIA will read these natively (which gains increased efficiency), however, any external analysis routines (such as those used in the photometry toolbox) will still need to be able to convert these files into NDFs, using the on-the-fly facility, so if you define your own conversion facilities make sure that you include a FITS converter (note these doesn't apply to FITS data cubes, GAIA handles converting these into NDFs for the various toolboxes directly).

To display any of these images in GAIA just type the full disk-file name on the command-line (either when you start GAIA or by using the `gaiadisp` command), or similarly select the disk-file in the open file window.

To display a FITS file extension image, either open the disk file and choose the extension from the `HDU` selector window that appears, or add the extension number to the disk-file name:

```
# gaia mef_file.fits'[2]'
```

The FITS primary array is number 1.

A similar mechanism exists for NDFs stored in container files at other than the top-level:

```
# gaia hdscontainer.ndf_1
```

In this case any other NDFs stored at the same level in the container file will also be shown in a selector window. NDF slices can also be used:

```
# gaia hdscontainer.ndf_1'(200:500,100:700)'
```

This can also be applied to FITS files and other foreign formats, but note that this means that FITS files will now be accessed as foreign, *i.e.* the FITS files will really be NDFs:

```
# gaia file.fits'(300:700,300:700)'
```

3.7 SAMP interoperability

SAMP stands for Simple Application Messaging Protocol. It is a protocol which allows tools on the desktop to communicate with each other. Very briefly, the way it works is that applications can send messages to a central `hub process` which will then pass them on to other applications which can respond to them in some appropriate way. GAIA can use SAMP to send and receive images, sky position information, and catalogues or identification of rows within them. It can also send extracted spectra. You will require a hub, either free-standing or integral to some other application, to use these capabilities.

You can find more information about how it works, what applications are compatible, and how it can be useful at the SAMP[12] web page. To remove the `Interop` menu you can use the `Startup options...` window located in the `File` menu.

SAMP is an evolution of the earlier similar protocol PLASTIC[13]. PLASTIC support, which was provided in earlier versions of GAIA, has now been withdrawn in favour of SAMP.

4 Configuration options

GAIA has many options that can be defined when starting it up. *These are best set using the Startup options... window located in the File menu*, but you also define these on the command-line:

---

[12]http://www.ivoa.net/samp/
[13]http://plastic.sourceforge.net/

option	Meaning
-autoscale	Auto scale image to fit window (disables zoom)
-autofit	Auto fit new images to window
-always_merge	Merge primary and extension headers
-blank_color	Colour for blank pixels
-catalog	Open windows for the given catalogs on startup
-check_for_cubes	Check input files to see if they are cubes (1)
-component	NDF component to display on startup
-component	The NDF component (data, variance or quality)
-default_cmap	Change the default colour map
-demo_mode	Make the demo toolbox available
-extended_precision	Show milliarcsecond readout precision
-float_panel	Detach the control panel
-focus_follows_mouse	Image and entry focus follows mouse pointer
-force_degrees	Display decimal degrees in main window readout
-font_scale	A scale for non-pixel display fonts
-geometry	A geometry for the main window
-ident	A string to add to the window titles
-interop_menu	Reveal the Interop menu for SAMP interactions
-image_background	Colour for the background of the main image
-isize	Search box for centroiding (9)
-linear_cartesian	Assume CAR projections are a linear mapping
-maxshift	Maximum shift when centroiding (5.5)
-pick_zoom_factor	Default scale factor used in pick object window
-pixel_indices	Display NDF pixel indices as X,Y
-quiet_exit	Issue a warning before exiting GAIA (0)
-show_hdu_chooser	Automatically show the HDU chooser
-transient_tools	Make toolboxes transient
-transient_spectralplot	Make spectral plot window transient
-visual	X visual (pseudocolor, truecolor, visual id)
-with_colorramp	Display a colour ramp
-with_pan_window	Display a pan window
-with_zoom_window	Display a zoom window

The full list of options can be seen using the `--help` option.

So for instance if you wanted to float the control panel (useful for smaller displays) and have a grey default colourmap. Then start using the command:

```
% gaia image_name -default_cmap ramp -float_panel 1
```

Or alternatively to save some space without floating the panel try:

```
% gaia image_name -with_zoom_window 0 -with_pan_window 0
```

(1 means true and 0 false).

If you'd like the toolboxes to remain on top of the display window they are associated with then set the `transient_tools` option to 1 (the precise behaviour you get depends on your window manager[14]).

If you prefer to point at the image and text entry fields before using the keyboard, rather than having to click in them first, then use the command:

```
% gaia image_name -focus_follows_mouse 1
```

Some additional configuration options are only available using environment variables. The most useful of these is the `GAIA_TEMP_DIR` variable, that defines a directory that will be used for writing most temporary files. The default is to write these into the current directory which can be a problem when working on read-only data.

4.1   Proxy servers

Access to the World Wide Web may be restricted (by a firewall or maybe just site policy), so that it is only available through a "web cache" or proxy server. If you are in this situation you'll need to configure GAIA so that its remote catalogue access will work.

To do this, start up GAIA, select the `Data-Servers` menu and choose any remote catalogue. Now in the catalogue window select the `Options` menu and choose the `Proxies...` item.

Now fill in the two fields (consult your system administrator if you're unclear what to enter here) and press `OK`.

4.2   Add new colour and intensity maps

The default set of colour and intensity maps used in GAIA can be extended by adding new ones to the `~/.skycat/colormaps` directory. Colour maps are simple text files with three columns, each column represents the Red, Greed and Blue fractions for values in the range 0 to 255, so the file should have 256 rows and three columns of values in the range 0 to 1. Intensity maps should also be in this format, but just have one column with values in the range 0 to 1. Finally colour maps should have the file extension `.lasc` and intensity maps `.iasc`. The basename of the files should be unique and not match those of any existing colour and intensity maps, if they do so then the existing maps will be superceded. The maps themselves can only be found in the `View` menu window `Colors....`

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[14]Even if you don't have `transient_tools` set, window managers can still cause many perceived problems dealing with toolboxes. Make sure that you have 'autoraise' and 'autoraise on first focus' type options switched off, if you feel that toolboxes and dialogs unnecessarily take charge of things like the focus.

5   GAIA demonstration

Rather than just absorbing the rather dry descriptions above, you can see some of GAIA facilities in action in a special demonstration mode. To activate this set your current working directory to an empty one (with several megabytes of space free). Now select the item `Demonstration mode...`, under the `Image-Analysis` menu and answer `yes` when a dialog window offering to unpack the demonstration files appears. After a while a toolbox window will reveal itself, just press the "Start" button to see the demo. Note that the demonstration contains flashing images.

6   Finding out more about SkyCat

SkyCat was developed at ESO as part of the VLT project and much documentation is available about the internals of how SkyCat (and consequently GAIA) are constructed. If you are interested in finding out about these then consult the postscript documents, which you can find from links on the SkyCat homepage[15]. The documents relevant to the version of SkyCat that GAIA is based on are also available at `http://astro.dur.ac.uk/~pdraper/gaia/docs`. People who would like to extend SkyCat or GAIA at the user interface level are recommended to read about "SkyCat plugins".

7   Acknowledgements

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The 3D facilities of GAIA make extensive use of the VTK library. Also a free library.

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[15]http://archive.eso.org/skycat/
[16]http://tcl.activestate.com/
[17]http://www.tcltk.com/