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GAIA: Recent Developments

P. W. Draper

Starlink, Dept. of Physics, University of Durham, DURHAM, DH1 3LE, U.K.

Abstract. GAIA, the Graphical Astronomy and Image Analysis Tool, is a derivative of the ESO Skycat program. It is being actively developed in the U.K., by the Starlink project, as a way of providing a graphically rich and interactive environment for doing 2D astronomy. Skycat provides a fundamental image, graphics and web catalogue context, which GAIA extends by providing image analysis tools. This article describes new tools recently added to GAIA and gives a brief description of the technologies that underly it.

1. Overview

GAIA[1] provides an interactive environment for performing graphical 2D astronomy. Latterly this encompassed things like aperture photometry, arbitrary region analysis, defect patching, blink comparison, astrometry gridding, astrometric calibration and celestial coordinate system switching. More recently these facilities have been extended to provide contouring, automated object detection and optimal photometry, as well as more general improvements, such as the ability to transfer astrometric reference positions between images.

GAIA presents an apparently well integrated interface, but makes extensive use of existing components – i.e. external programs. Starlink applications may be loaded into memory and controlled using a messaging system. Ordinary command-line programs can be executed as normal. For instance the processing engine of the photometry toolboxes is provided by the Starlink package PHOTOM and the object detection toolbox uses the SExtractor program.

GAIA, as a program, is a working complex heterogeneous assemblage of scripting and programming languages, bound together using Tcl. New Tcl commands are implemented with code written in C++, C and Fortran. Much of GAIA is implemented in an object oriented fashion using [incr Tcl] and by sub-classing the many facilities of Skycat (such as data and catalogue access). Highly specialized facilities, such as Starlink format data access and complex astrometry functions, are provided by reusing existing libraries of functions.

[1] `http://www.starlink.rl.ac.uk/gaia/`

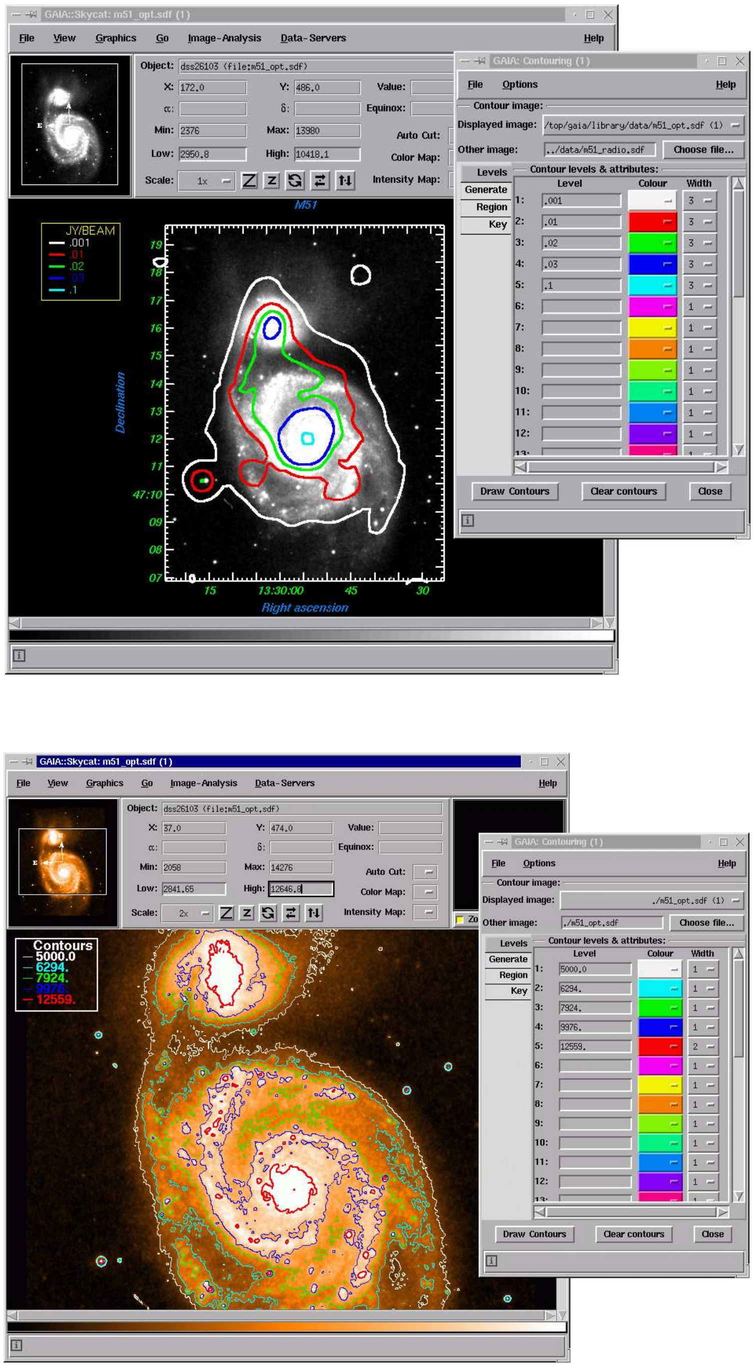

Figure 1. **Contouring:** bottom – optical image of M51 with overlaid with self-contours. Top – same picture of M51 but with radio flux contours. The contouring toolbox provides control of the line colors and widths, individual contours may also be redrawn. Inter-image registration is performed by the Starlink library AST library (Warren-Smith, 2000).

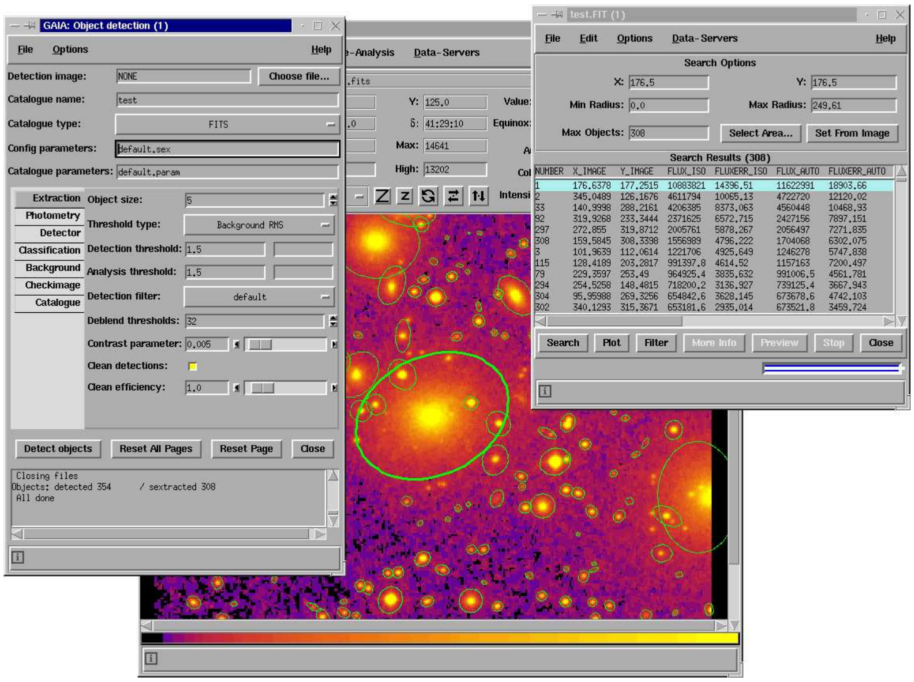

Figure 2. **Object Detection:** GAIA after a pass to detect all the objects on the displayed image has been made. The objects are actually detected by Emmanuel Bertin's SExtractor program (run straightforwardly as a forked process) and displayed in a Skycat catalogue window. The catalogue window allows you to make simple queries and inspections of the data, it is also extended to provide centering on the selected object (as shown).

Since GAIA is really a subclass of the VLT/ESO SkyCat[2] tool, it shares and extends Skycat's abilities. For instance GAIA can be remotely controlled and new script-level facilities can be written as user loadable "plugins".

Acknowledgments. GAIA is a derivative of the Skycat[3] image display and catalogue browsing tool, developed as part of the VLT[4] project at ESO[5]. Skycat is free software under the terms of the GNU copyright.

References

Warren-Smith R. F. 2000, this volume, 506

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[2]`http://archive.eso.org/skycat/`

[3]`http://archive.eso.org/skycat/`

[4]`http://www.eso.org/vlt/`

[5]`http://www.eso.org/`

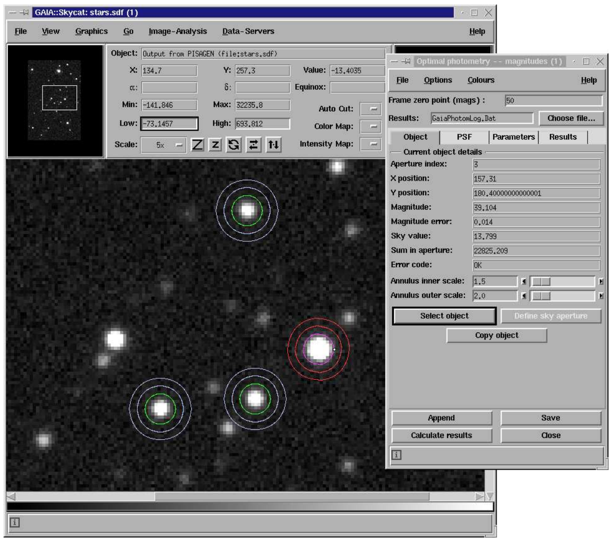

Figure 3. **Optimal Photometry:** GAIA performing optimal photometry on an image. All apertures are constrained to be the same size and can be moved individually. The darker/red aperture is used to create a PSF profile, other panes of controls list the complete set of measurements and define the data characterization. The photometry measurements are made by the Starlink package PHOTOM loaded and controlled by the toolbox.

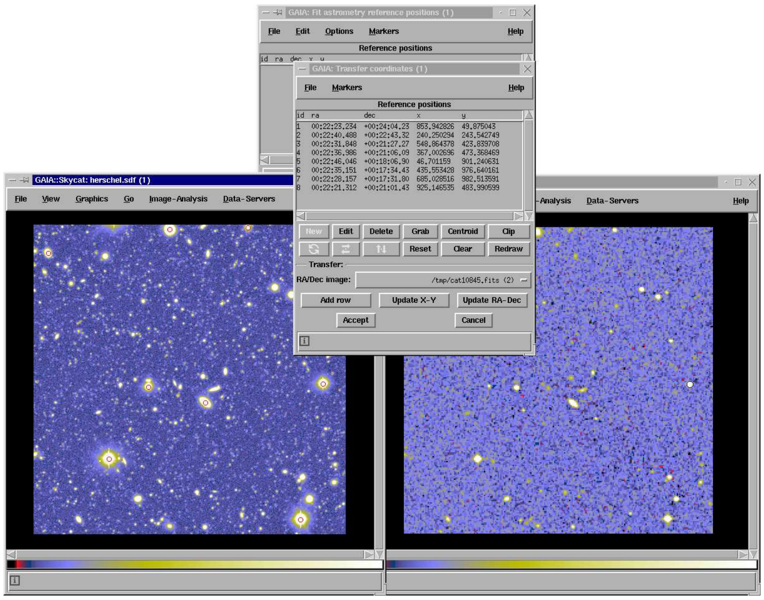

Figure 4. **Astrometric Calibration:** GAIA transferring reference positions from a calibrated image (a DSS image) to an uncalibrated image. The correspondence between the images is performed using point and click on a selected row.