GAIA3D: Volume Visualisation of Data Cubes

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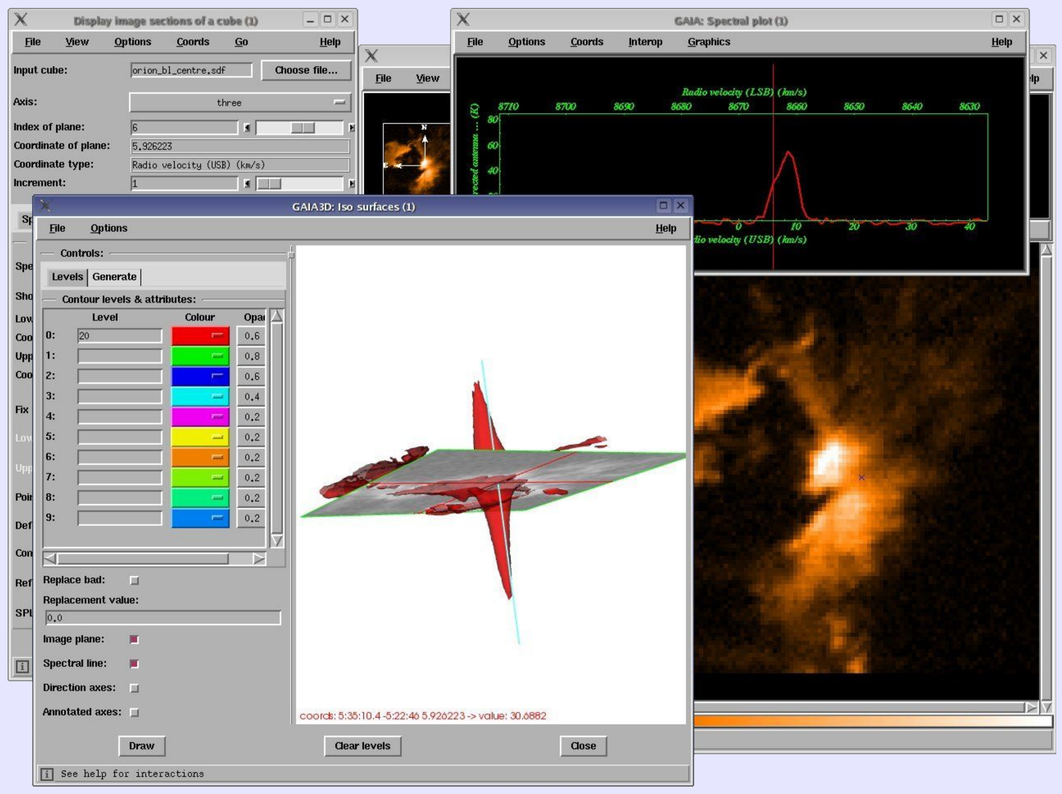
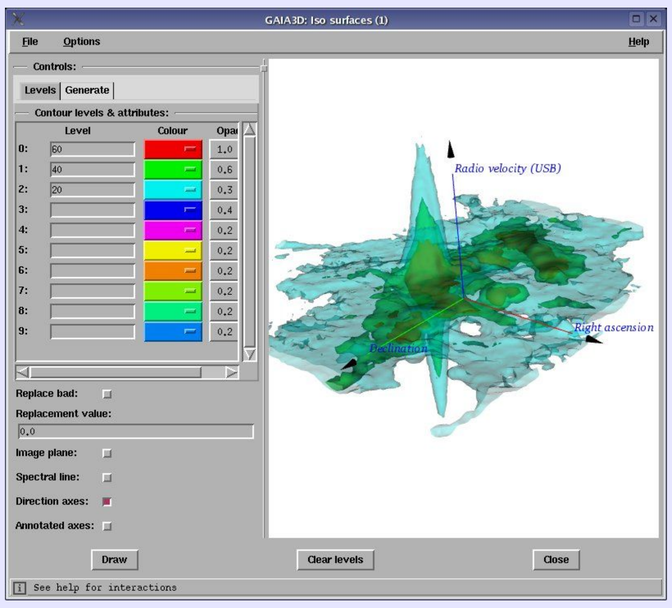
Introduction

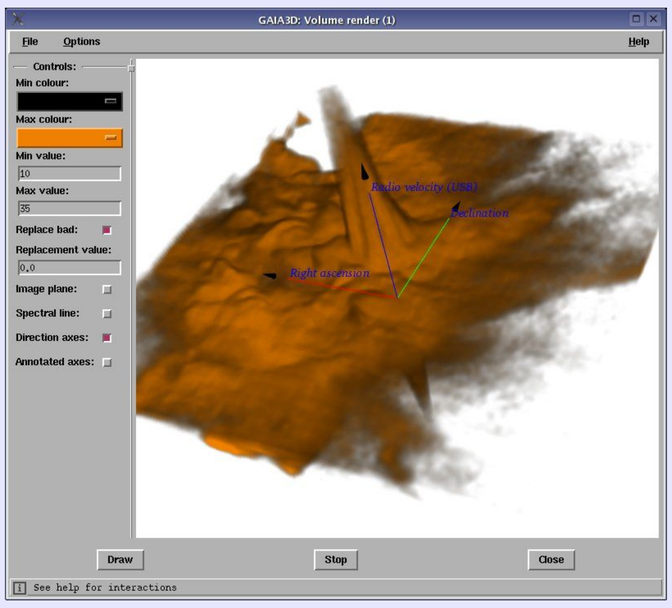
To compliment the already powerful data cube handling facilities of the Starlink GAIA application demonstrated at ADASS 2006, we have been extending it to provide integrated 3D volume and iso-surface rendering.

The expectation is that this work will result in a simple integrated system with support for astronomy data formats and coordinate systems that will limit the initial knowledge necessary to exploit 3D visualisation for data exploration and analysis. This poster shows some of the work done so far, using data from the ACSIS/HARP instrument now in use on the JCMT.





Iso-surfaces: Picture showing the new GAIA toolbox displaying a JCMT dataset (of the central parts of the Orion nebula) using isophotal contours at various levels and with various opacities to render the volume (using opacities allows you to see different depths within the outer volumes). A number of levels can be automatically suggested (based on the data displayed in the main GAIA window), or chosen to give logarithmic intervals. The data can be directly shared with GAIA, unless replacement of bad values is required. This isn't usually the case for contouring. Interaction with the image uses a series of mouse gestures, or the keyboard can be used for finer control. The cardinal directions of the data's world coordinates (in this case RA, Dec and Radio velocity) can be permanently displayed in the current view.



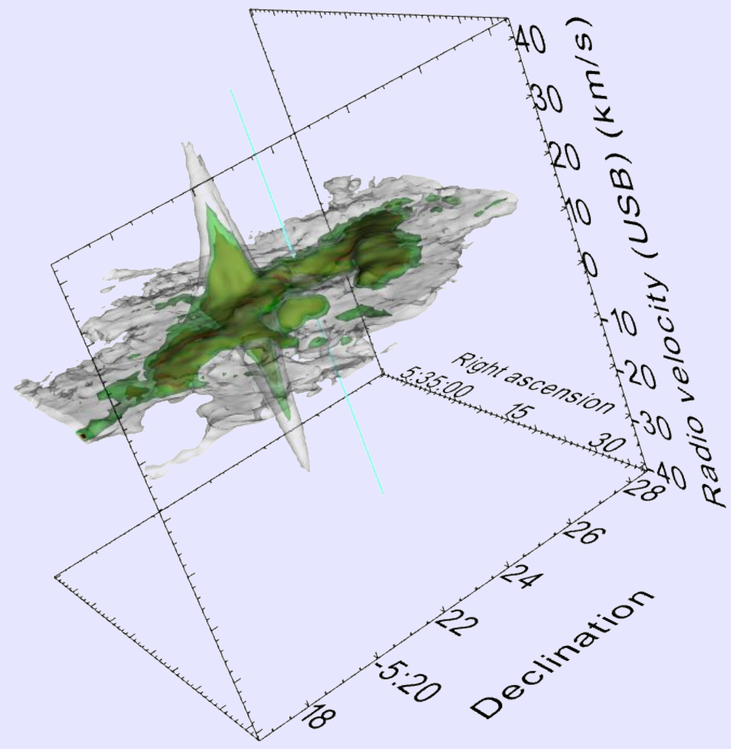
Volume rendering: a volume rendering of the same dataset. The colour transfer function is a simple mapping between two selected colours for the given data range. Volume rendering is sensitive to the presence of bad data values, so any blank values have been replaced with the value zero.

Astronomy support:

GAIA3D will handle data in NDF and FITS formats, in all data types. The world coordinates are handled by the AST library, which provides full support for all celestial coordinate systems and nearly full support for spectral coordinates (no -TAB), as defined in FITS Paper III.

AST is described in David Berry's poster (P1.054).

Interaction with GAIA: GAIA currently provides facilities for displaying slices from cubes, and extracting a point spectrum. These positions within the data-cube can now be visualised as a plane and a line. The positions of the plane and spectrum can be changed using GAIA in its traditional mode, or you can now move the plane and spectral line around within the visualised volume. When dragging over the plane a readout of the coordinates (RA, Dec and Radio velocity in this case) is provided, as well as the data value.



Annotated axes: Using the new Plot3D facilities of the AST library, annotated axes displaying labels in familiar sexagesimal formatting can also be displayed. In the picture above you can see one possible way of displaying these shown in a print, rather than a screen capture.

Future work:

GAIA3D is a work in progress and much remains to be done before a first release (this will happen as part of a future Starlink release by the JAC). Obvious work is extracting subsets of the volume (matched to the view used in GAIA), displaying region extracted spectra, and further testing. It is also an aim to visualise the results of segmenting the volume into significant clumps, as produced by the CUPID application. It will also be possible to view and interact with the catalogue of regions.

Technology and acknowledgements

The 3D rendering in GAIA uses the Visualization Toolkit, VTK. VTK is an open source C++ project, with wrappers for many scripting languages, including the Tool Command Language, TCL, in which much of the new extensions to GAIA are written.

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