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Aladin: An Open Source All-Sky Browser

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Abstract. Aladin, developed over 10 years at CDS, has evolved from a simple sky atlas to become a rich and powerful portal able to access, visualize and manipulate images and catalog data. Aladin is widely used in the Virtual Observatory community and beyond. Version 7 of Aladin is open source, and recent developments have been focused on enabling all-sky browsing targeted towards real scientific usage. Hierarchical, multi-resolution image surveys, density maps and catalogs have been created for popular datasets (DSS and Sloan images; Simbad and 2MASS catalogs data, for instance). Users can also easily build their own all-sky sphere from a set of local FITS images and share it through a simple URL link. Aladin features can be extended by external plugins. An SED (Spectral Energy Distribution) plugin, combining fluxes extracted from calibrated images and fluxes in VizieR photometric catalogs has been developed and is available.

Introduction

The first version of Aladin was released in 1999 as a basic FITS image visualizer, able to superimpose catalog data. It has since undergone several major enhancements, including the capability to search and access to Virtual Observatory services (2003), the multi-view mode (2005), and the interoperability with other desktop tools through the SAMP[1] protocol (2008).

Aladin version 7 marks another important milestone. This new release allows access to all-sky data and enables seamless all-sky navigation, following the trend started by NASA World Wind, Google Sky and World Wide Telescope.

Strong emphasis has been on providing astronomers with a flexible tool allowing them to easily browse datasets of interest in an all-sky mode, as shown in the next section.

1. All-Sky Features

We have developed and implemented a technique, based on the HEALPix tesselation and fully described in Fernique et al. (2010), allowing one to build a multi-resolution hierarchical view for different kinds of datasets: images, HEALPix files, coverage maps, and catalogs.

[1]Simple Application Messaging Protocol: `http://ivoa.net/samp`

Once this view has been built, the user can easily navigate it by using an intuitive browsing based on zooming and panning.

1.1. Image Surveys

We have built some all-sky views of several popular image surveys, including the Digitized Sky Survey, 2MASS, GLIMPSE in multiple bands, and IRAS.

In order to get some fast network access time, image surveys are loaded by default in JPEG, restricting the range dynamic to 8 bits. Users interested in getting the real pixel values can switch to a (slower) mode which will let them retrieve the full dynamic from FITS files. Combined with a crop tool, this mode can be used to perform photometry measurements.

Users are not limited to image surveys published by the Aladin team. We provide a tool (Oberto et al. 2011) so that they can also create their own multi-resolution views from a set of local FITS images. Generated views can then be easily shared, by making them accessible through a Web server.

1.2. HEALPix FITS Data

Data generated by the Planck mission will be published in HEALPix FITS format. This will also be the case for other upcoming surveys.

Aladin now supports this format natively. Figure 1 shows how a WMAP file including polarization data is displayed in Aladin.

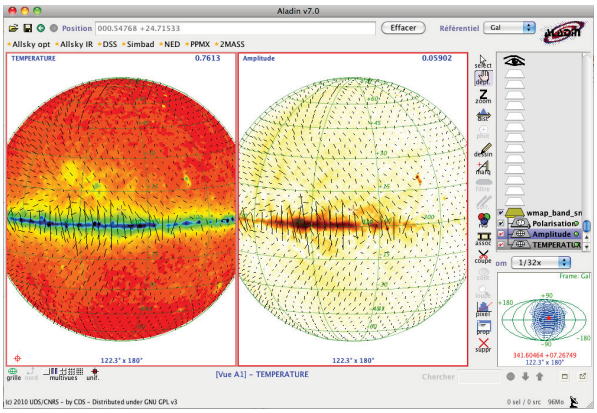

Figure 1. Temperature and polarization amplitude, as displayed in Aladin. The polarization segments are overlaid in black.

1.3. Coverage Maps

Taking advantage of our all-sky mode, we generated some HEALPix coverage maps for large catalogs, such as 2MASS, DENIS, SDSS DR7 or USNO-B1 (see Figure 2). In such a map, the pixel value represents the actual number of sources in the given HEALPix cell.

Those maps are very useful to compare catalogs footprints and infer regions of common coverage.

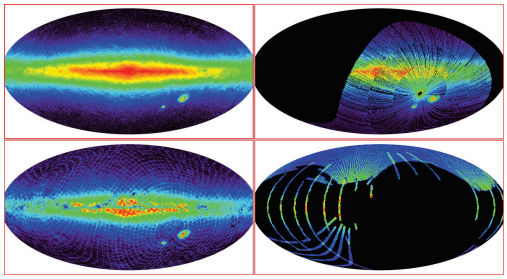

Figure 2. From top left to bottom right: coverage maps of 2MASS, DENIS, USNO-B1 and SDSS DR7 catalogs, projected in AITOFF.

1.4. Progressive Catalogs

Progressive display of catalogs are a new feature allowing one to browse very large catalogs without having to load all the sources beforehand. At the lower resolution, when the whole celestial sphere is displayed, we only load and display the more pertinent sources. Pertinence could be the flux of the sources (as for the 2MASS catalog) or the number of bibliographic references (for Simbad sources). As we zoom in, we load fainter and fainter sources, until all sources of the current field of view are displayed on the screen.

We applied this method to reprocess a number of large catalogs, including 2MASS, Tycho2, AKARI or PPMX, all available from the Aladin user interface.

2. Other New Features

2.1. Scatter Plots

2D scatter plots can be generated from any catalog loaded in Aladin. Figure 3 shows an example of linked views (Goodman 2010) in Aladin. The left panel displays the position of GLIESE sources overlaid on the SHASSA H-alpha survey, whereas the right panel shows a color-magnitude diagram for the same set of sources. Selecting a set of points in one of the views will be automatically reflected in the other one, allowing easy comparison of the spatial and parameter dimensions.

2.2. Bookmarks

Common tasks can be easily stored in bookmarks and reused at will. Bookmarks are defined using Aladin script commands. Below is an example of a bookmark which will load an IRAS image for the current field of view and display the corresponding isocontours.

```
function IRASContour($TARGET, $RADIUS) {
   IRAS = get aladin(IRAS,60) $TARGET
   contour 6 nosmooth ; rm IRAS ; select @1
}
```

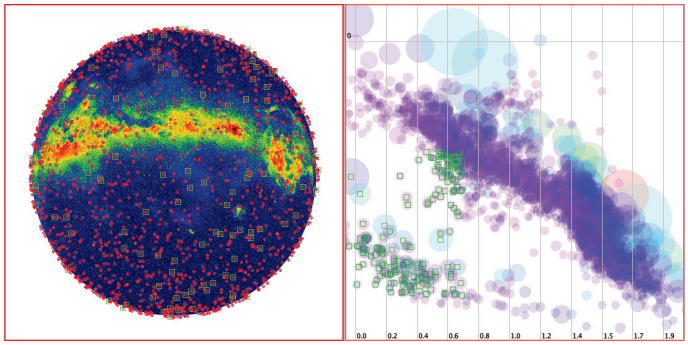

Figure 3. Left panel: GLIESE sources overlaid on an H-alpha survey. Right panel: color-magnitude 2D plot for GLIESE sources.

3. SED Plugin

A plugin mechanism allows any software developer to take advantage of the Aladin framework in order to add new features.

An SED plugin has been developed internally at CDS.[2] It combines fluxes extracted from images and magnitudes or fluxes coming from catalogs, taking into account proper characterization of those data, to generate and display a SED plot.

4. Licensing and Download

Aladin is open source as version 7 and is released under the GPL 3 license.[3] We firmly believe that open sourcing Aladin will facilitate collaboration and enhance trust in our software as well as its long-term sustainability.

Aladin release 7 is available for download at `http://aladin.u-strasbg.fr/java/nph-aladin.pl?frame=downloading`.

References

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Goodman, A. A. 2010, in American Astronomical Society Meeting Abstracts #215, vol. 42 of BAAS, #230.03

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[2] `http://aladin.u-strasbg.fr/java/plugins/SedPlugin.jar`

[3] `http://www.gnu.org/licenses/gpl-3.0.html`