

## PocketVO – A Simple Tool for Accessing Multiwavelength Images through the VO

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**Abstract.** Several existing Web-based tools allow users to access astronomical images and data from different surveys, almost all integrated with or accessible via Virtual Observatory (VO) portals. These tools are often too complex for most untrained users, including students and amateur astronomers. In this paper we present PocketVO, a simple interface to existing services such as the Sesame name resolver and many image cutout services. PocketVO provides a simple interface for untrained users for the display of astronomical images. We provide examples and also discuss possible extensions.

### 1. Introduction

Several Web-based tools that allow users to access astronomical images and data from different surveys, e.g. the Sloan Digital Sky Survey SkyServer<sup>1</sup> (Nioto-Santisteban, Szalay, Gray 2003), DataScope<sup>2</sup> (McGlynn et al. 2003), *SkyView*<sup>3</sup> (McGlynn et al. 1996), and others, e.g. via SIAP (Simple Image Access Protocol) services through the Virtual Observatory (VO) portal.

These interfaces, though powerful and flexible, are often complex and puzzling for some categories of users, specifically those who are not acquainted with the VOs and the organization of their data. This includes students, amateur astronomers, researchers new to VO-enabled astronomy and other users that just want simple answers for simple questions.

To provide such users with a tool that meets some of their expectations and requirements, we developed PocketVO a simple graphical user interface to existing services such as the Sesame name resolver and image cutout services (Sloan Digital Sky Survey and *SkyView*).

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<sup>1</sup><http://cas.sdss.org/dr6/en/>

<sup>2</sup><http://heasarc.gsfc.nasa.gov/cgi-bin/vo/datascope/init.pl>

<sup>3</sup><http://skyview.gsfc.nasa.gov/>

This paper presents the tool and some considerations on its development and deployment, with ideas for future implementation.

## 2. Development of PocketVO

The first version of PocketVO was developed as a simple server-client application during the 2006 US NVO Summer School. The server was a form-based interface to the Sesame and SkyServer web services, and *SkyView* cutout services.

The tool allowed the user to enter either an object name (which was resolved by Sesame into right ascension and declination coordinates) or the object's coordinates, a view scale and a wavelength type. With this data, the server chose the best possible survey for a particular wavelength (defaulting to an all-sky survey), and sent the image corresponding to those coordinates, scale and survey to the client.

The second version was developed with views to a more robust server able to deal with multiple simultaneous requisitions. The server also attempted to cache the images for the selected region in different wavelengths to accelerate its display, using a so-called *concierge* that also informed the client, asynchronously, of the availability of other images for the region. The client side was able to display two images of the same region with different image sources, for comparison.

The client for the third version of PocketVO was rewritten as a Java applet to improve interaction with the server. This client can be used with *starting points*, which are links that execute it with a preloaded set of coordinates, objects and surveys, allowing the user to explore of known and specific objects.

The third version's usability was considered satisfactory except for the speed issue – the server is located in Brazil and there is a considerable delay imposed by the centralization of image downloading. One solution for this issue would have been the use of faster connections or geographical distribution the servers, but we considered that solution too complex and/or costly.

### 2.1. Present Version and its Architecture

Most of the code of the Java applet client was reused for the fourth version of PocketVO. We have moved the server functions to a full client-side application (in Java), eliminating the need of both the *concierge* and cache mechanisms.

The client has a full, rich, MDI (multiple-document interface) graphical user interface. Each window can display up to three images for a particular region, in different surveys. Since multiple windows can be opened at the same time, the user can compare different objects using different windows.

The concept of *starting points* was extended so the windows in the user interface can be stored in a XML file, so that the user can load (from a file or from a URL) and save (in a file) the windows' configurations for sharing.

The application can be distributed either by a JAR file or using Java Web Start. The main advantage of using Java Web Start is that updates are automatically downloaded. The user does not need special privileges to run the application since installing is not required, but he/she must have version 5 or later of the Java Runtime Environment pre-installed.

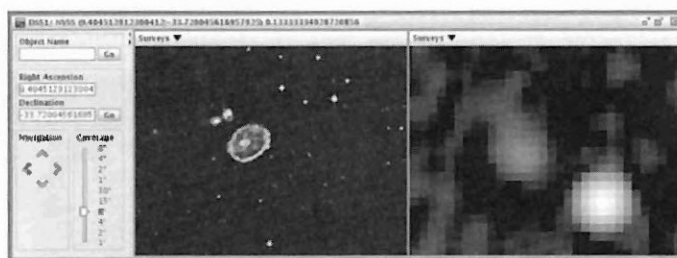


Figure 1. Screenshot: The Cartwheel galaxy in visible (DSS1) and radio (NVSS) wavelengths.

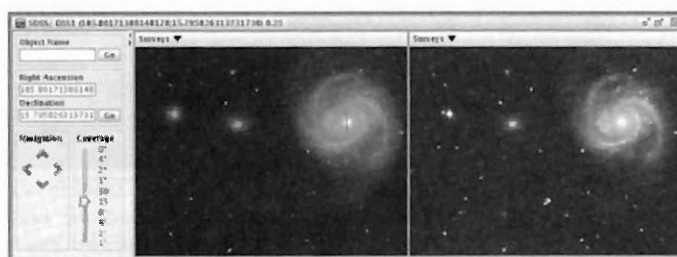


Figure 2. Screenshot: Region around M100 in visible wavelengths (SDSS and DSS1).

### 3. Using PocketVO

PocketVO was designed with untrained users in mind, so its interface is as simple and uncluttered as possible. The user is presented with fields to enter either an object name or its coordinates, and a slide bar to select the coverage (size of sky that will be displayed in the window). The user can navigate on the image using buttons or click on any region on the image to recenter it on the clicked object. Menus for each image panel allow the selection of the wavelength type and survey for that panel.

#### 3.1. Examples

Figure 1 shows a strong radio source in a region close to the ESO 350-G40 (Cartwheel) galaxy in visible (Digitized Sky Survey) and radio wavelengths (NRAO Very Large Array northern sky survey).

Figure 2 shows two visible images from different surveys (Sloan Digital Sky Survey and Digitized Sky Survey) from a region south of the M100 galaxy, with some objects present in one survey but not on the other.

Figure 3 shows the new PocketVO interface, with several independent windows on it.

The latest version of PocketVO and its source code can be downloaded from <http://www.lac.inpe.br/~rafael.santos/pocketvo.jsp>. Commented source code and development tutorials are provided to encourage other developers to modify and extend the tool.

web portal<sup>6</sup>. The web application displays the footprint of the real-time search and the results page links to Aladin browser.

An image composition process has been designed, using the SWarp software<sup>7</sup>. After both images from ESO-R and a SRC-J are resampled in the same tangent plane and at the same resolution, a RGB composition can be done (see Figure 1).

Thanks to the astrometric quality of the material and the accuracy of the procedure used, the structures present in the central parts of NGC 55 are well rendered by the composition, although that galaxy was located close to the edges of two adjacent ESO fields.

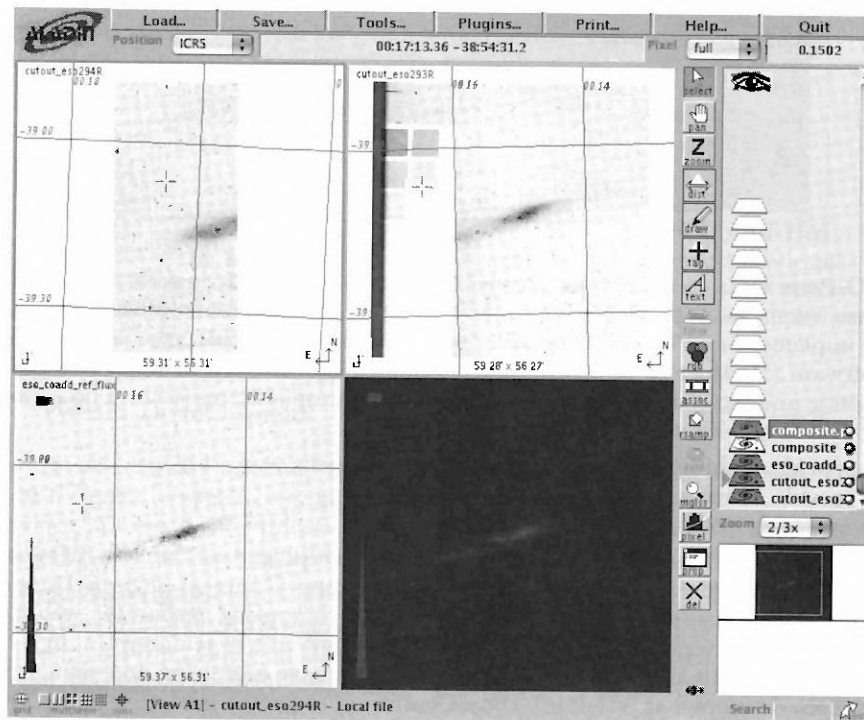


Figure 1. Aladin Java is used to display the RGB composition from the mosaicing with SWarp of two cutout images from the ESO-R survey.

### 3. Simulation Codes<sup>8</sup>

Numerical simulations are fundamental in astrophysics either to prepare missions, to interpret observations or for theoretical studies. We have developed

<sup>6</sup><http://www.cai-mama.obspm.fr/mama/>

<sup>7</sup><http://www.terapix.fr/>

<sup>8</sup><http://vo.obspm.fr/simulation>

a procedure to provide access to simulation codes and computing facilities in the VO, and built a tool to analyze simulation results. These developments are based on IVOA standards and this presentation is based on Meudon PDR Code (Le Petit et al. 2006). Providing a user-friendly access to this code is useful for ALMA and the preparation of the Herschel mission.

### 3.1. Access to Simulation Codes

The Meudon PDR code has been registered in the Astrogrid portal of VO-Paris. The access to simulation codes can be done online through a user-friendly interface using Astrogrid to communicate with computing facilities. Using the code involves the following steps:

1. The user inputs the parameters of the model using a dynamical interface.
2. Parameters are sent through Astrogrid to the computing facilities of the Observatory of VO-Paris data centre. Simulation results are stored in MySpace (the distributed data storage used by Astrogrid).
3. User can access results through MySpace and visualizes them with data analysis tools.

### 3.2. Description of the Simulation Results

Simulation results are provided in two files: a binary FITS file and a XML VOTable file. Data from the simulation results are stored into the FITS file whereas the VOTable file describes all available physical quantities. Each description of a quantity includes the metadata as its unit, datatype, UCD, related axis and localization in the FITS file. This VOTable file also describes how data have to be ordered. We have used a keyword system to match the description of a quantity with its data.

### 3.3. Results Analysis Tool

To analyze simulation results, a graphical user interface has been implemented in Java. The GUI can load simulation results locally or directly from MySpace and interpret the VOTable file to display the available physical quantities in a data tree (see Figure 2). Each quantity can be accessed as a table of data, then exported into ASCII or VOTable format or plotted with an embedded plotter or any plasticized tools.

In addition to these simple possibilities, the tool also provides:

**Plastic support** to send selected quantities to other plasticized applications.

**Script mode** CLI for batch processing. The scripts are written in XML. The knowledge of XML syntax is not necessary as a script builder is provided.

**Plug-in mechanism** to extend data processing by writing your own plug-in.

### 3.4. Future Work

- On-line images services such as source extraction resampling, etc.
- Application to other simulation codes (radiative transfer, stellar synthesis population, MHD, cosmology...).
- Development of databases for compatibility of numerical simulation results with the Simple Numerical Access Protocol (SNAP)

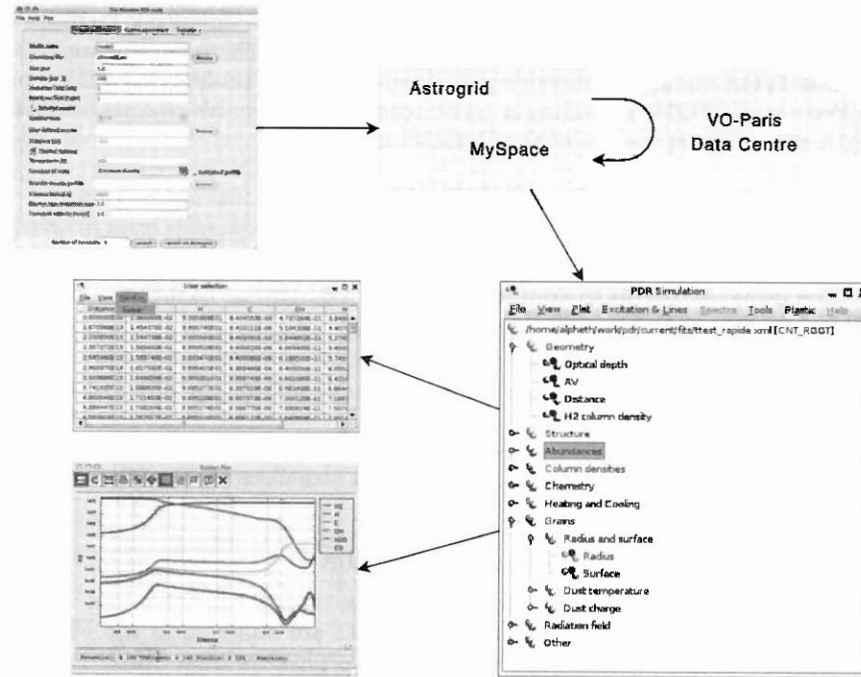


Figure 2. Access to numerical simulation codes and results.

- Compliance of Java client with SNAP
- Interoperability of the numerical simulation codes using workflow protocols

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