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ASPRO2: A Modern Tool to Prepare Optical Interferometry Observations

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Abstract. We present ASPRO2, a Java observation preparation tool developed and maintained by the Jean-Marie Mariotti Center for Expertise in Interferometry (JMMC). ASPRO2 allows to prepare observations for optical interferometers, in particular for the VLTI and CHARA arrays. It automates the writing of VLTI and CHARA Observing Blocks. ASPRO2 persistent metacode can be used to exchange observation lists between observers or even instruments. Relying on Virtual Observatory techniques, ASPRO2 is interoperable with other applications, in particular those developed at JMMC for optical interferometry.

1. Introduction

`ASPRO2` is the second version of the Astronomical Software to PRepare Observations created by the JMMC.[1] It is quickly replacing its predecessor, `ASPRO` (Duvert et al. 2002; Mella & Duvert 2004). `ASPRO` was also a complete observation preparation tool for preparing interferometric observations with the ESO/VLTI. It was based on a client-server model, with a light Java display interface on the client side and a complex server side, relying on a special "network-aware" version of the `GILDAS`[2] software suite, a series of `FORTRAN` and `C` programs and `SIC` scripts.

Initially intended as a demonstrator only, `ASPRO` had a long and useful life (10 years), but is now difficult to maintain and improve due to its dependency to obsolete components. Based on the numerous positive returns and evolution requests from the community, the JMMC Scientific Council started the `ASPRO2` project in September 2009.

`ASPRO2` is a Java standalone program improving on all the functionality of `ASPRO` and adding a dynamic graphical interface, the abilities to be used off line, to load and save observation settings, to generate Observing Blocks, and much more. `ASPRO2` is developed in close relationship with a panel of users, in an AGILE-like development environment.

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[1]`http://www.jmmc.fr`

[2]`http://iram.fr/IRAMFR/GILDAS`

2. Functional Description

ASPRO2 is designed to prepare observations with a variety of long baseline optical interferometers. Although some prior knowledge of interferometry is preferable when dealing with such a specialized tool, we have tried to design an intuitive user interface (GUI). We also insist on keeping the GUI as simple as possible and dealing only with the parameters really needed to prepare an observation, using interoperability with other VO tools to fulfill additional user needs.

Preparing an observation in our case is very much alike simulating the whole observational process, since in the absence of a directly interpretable result (such as an image would be, for example), the astronomer needs to use data interpretation tools such as model-fitting or image-reconstruction programs to estimate the feasibility of the observations, something which is not readily conveyed by a simple "exposure time calculator". Thus, ASPRO2 is internally designed as simulator and produces simulated observables in the data format, data format!OI-FITS OI-FITS (Pauls et al. 2005), used by the optical interferometry community.

2.1. Data Model

ASPRO2 is based on a Data Model to easily maintain and update the configuration for interferometers, instruments and observations:

- The interferometer itself, with its constituents and relevant parameters: telescope(s) size(s), stations positions, optical path lengths, delay lines throw, atmospheric conditions, etc. The interferometer "section" of the data model is named from the actual interferometer (e.g., CHARA, VLTI) and roughly corresponds to the OI_ARRAY table of the OI-FITS format.

- The instrument used, with its related properties: transmissivity, bandwidth, number of spectral channels and resolution, detector properties, etc. The supported instruments at the time of writing are AMBER, MIDI, VEGA, CLIMB, CLASSIC, MIRC.

- The instrument noise figures. At this time we have an all-purpose "generic" noise model valid for any fibered recombiner (monoaxial/multiaxial).

- The science target itself, with several basic properties (RA, DEC, magnitude, proper motion, etc., usually retrieved on-line from the CDS database), and a structural model based on a collection of simple parametric models, such as point source, elliptical disk, Gaussian, etc. In the future, we will provide support for user-defined models (a functionality already present in ASPRO).

Adding new interferometers or instruments is just a matter of editing our simple XML configuration file.

2.2. ASPRO2 as a Workflow

Due to its "simulator" properties, ASPRO2 has a workflow-like structure. It structures and sequences the different steps needed to simulate the observation and produce the interferometric observables:

- Retrieve the object or object list basic parameters.

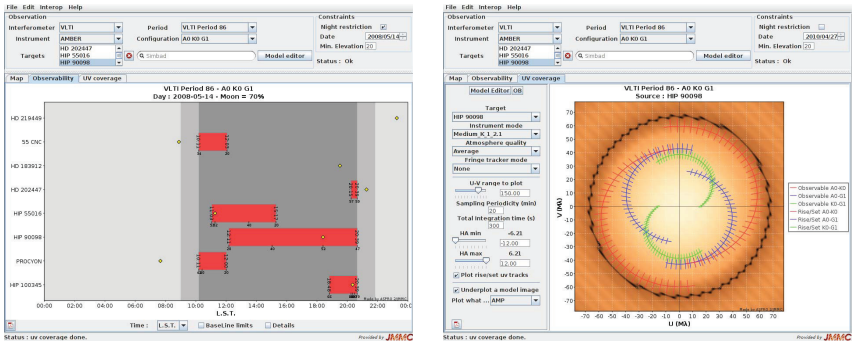

Figure 1. Some aspects of the ASPRO2 GUI. Left: the GUI with the "Observability" tab selected. It summarizes the observability of all the objects included in the observation preparation, and serves as a chart for planning a night of observation. Right: with the "UV Coverage" tab selected. It permits to assign a model to an object, find the best telescope configuration for observation of this object etc... The image in the background is the Fourier transform of the object's model (in this case a giant star with a faint companion).

- Select the interferometer and instrument.
- Compute an **Observability Chart** based on the interferometer configuration, the night restriction for the observation date chosen, the minimum elevation, the delay line compensation for the selected base lines, telescope shadowing (for VLTI), zenithal constraints, etc.
- Select model for each object. ASPRO2 shares its model editor with our model-fitting program LITpro (Tallon-Bosc et al. 2008).
- Compute for each object the **UV Coverage** from the object's observability, the object's model, the instrumental configuration, the geometrical delays and constraints.

2.3. The Graphical User Interface

We have tried to keep the GUI of ASPRO2 simple. Figure 1 shows two examples of the GUI panel. The upper part of the GUI groups the information or entry points common to the whole observational project. Below, a tabbed panel groups different kind of "views" needed by the preparation process. At the moment only three tabs are present, the Map of the Interferometer, the Observability and the UV Coverage. This will be completed in a future release by another tab with the OI-FITS visualization panel, that we are building as an independent, interoperable tool.

2.4. Interoperability

ASPRO2 uses SAMP to interact with other VO-compliant, "SAMPified" applications, in particular two JMMC tools:

- SearchCal (Bonneau et al. 2006), the JMMC tool to find calibrators for the planned observations (and get back the star list in ASPRO2).

- `LITpro` (Tallon-Bosc et al. 2008), the JMMC tool to fit models in interferometric observables, applied here to the OI-FITS simulated by `ASPRO2`.

Besides, `ASPRO2` is also able to pass VOTables to, e.g. `Aladin`.

Acknowledgments. We wish to acknowledge the use in `ASPRO2` of the following components:

- The `JMCS`[3] Shared library providing GUI and common features.
- `JskyCalc`[4] which is to our knowledge the only Java library available dealing with ephemeris, astronomical coordinates conversions, etc.
- `nom.tam.fits`[5] which provides FITS file handling. We added the support of single and double-precision Complex values and handling of the COMMENT and UNIT keywords
- `JFreeChart`[6] handles all vector plots and provides science-grade exports in SVG or PDF (meaning that they can be used directly as illustrations in proposals or publications, an important feature frequently absent from JAVA-based graphical tools).
- `JSAMP`[7] for the SAMP VO query protocol.
- And SIMBAD[8] to retrieve many of the needed object's information (position, magnitude, proper motions, etc.) with a simple name query.

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[5]by Dr. Thomas A. McGlynn, HEASARC

[6]see `http://www.jfree.org/jfreechart`

[7]by Mark Taylor, AstroGrid

[8]Centre de Données Astronomiques de Strasbourg, `http://simbad.u-strasbg.fr/simbad`