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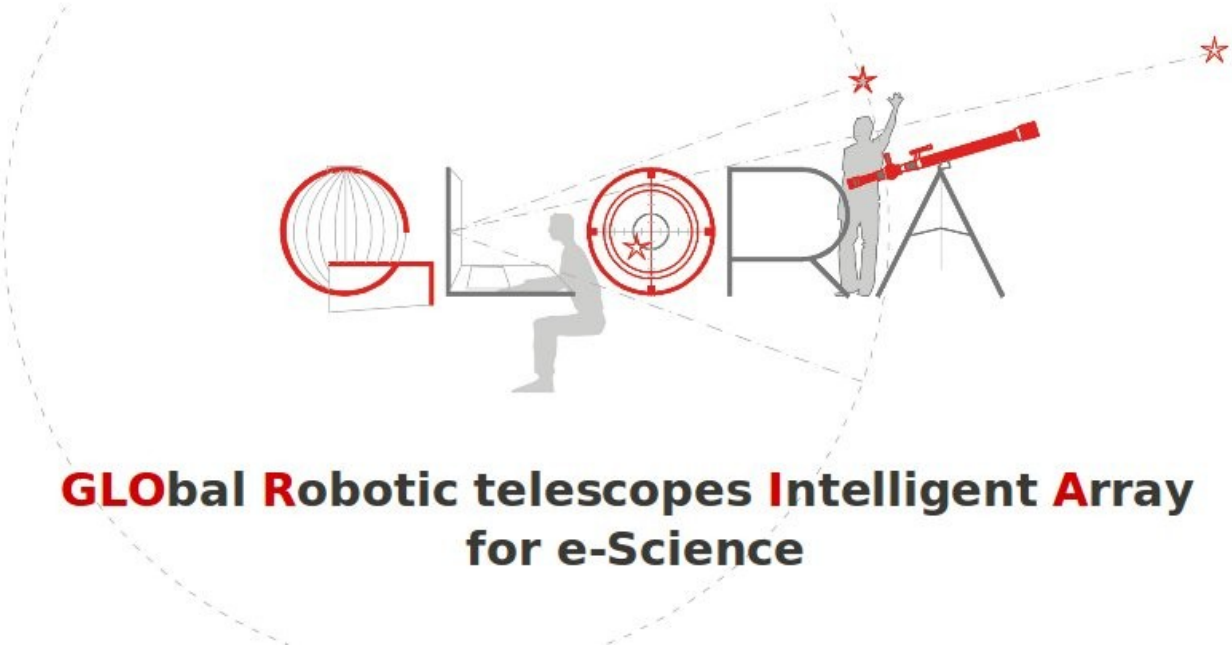

User web interface for offline experiments available

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1. Introduction

The first year of the project was devoted to the definition of standards, as well as development of tools and algorithms for implementing on-line and off-line experiments in the GLORIA network. Preparations were concluded with the following milestones reached by M12:

- 8.1 Educational level off-line demonstrator experiment ready for installation in the network.
- 8.2 On-line demonstrator experiment ready for installation in the network.
- 8.3 Research level off-line demonstrator experiment ready for installation in the network.

Next step, which resulted in this deliverable, was to make the developed tools available to GLORIA users. Some tools are shared between on-line and off-line experiments.

This deliverable describes the users tools related to off-line experiments. Corresponding description for on-line experiments can be found in Deliverable 6.1.

User interface for doing GLORIA off-line experiments has been made available to users at the location:

http://users.gloria-project.eu/

Documentation of all tools, together with the detailed descriptions of the proposed experiments can also be found there. This document gives only a brief summary of the available functionality and main implementation aspects. We conclude with presentation of the plans for the next months.

2. Description of experiment interfaces

2.1. Available functionalities

Implemented tools and their functionalities are described in the order they are supposed to be used by GLORIA user, corresponding to steps user has to take to participate in GLORIA experiments.

- **Creating GLORIA account**

  Only registered users get full access to GLORIA network resources and are able to run all experiments. Registration is very simple. From the main web page one has to select ‘Sign in’ and then ‘Create account’. To be registered user has to give his/hers full name, screen name (to be used on the web pages; full name remains confidential, as do remaining personal details) birthday, gender and email address. Confirmation link is sent to the specified e-mail address to verify that it is correct. The initial password is also sent to this address. The whole procedure takes about 1 minute, after which the user is able to sign in to the GLORIA users web portal.

  We assume that users which have not registered to GLORIA will still be able to get access to some off-line resources, including selected off-line experiments. This will allow them to get familiar with GLORIA and should encourage them to register. Currently we allow unregistered users to access Venus Transit data and perform related demonstrator experiment (see below).

- **Browsing available experiments and their documentation**

  After registering, user can check the list of available on-line and off-line experiments. Currently two demonstrator off-line experiments are made available: one based on Venus Transit data (allowing to calculate Sun-Earth distance) and the second one on the whole-sky images from BOOTES system (allowing to observe the planet movement on the Sky). In the coming months another demonstrator experiment, based on Pi of the Sky data, will be added, focusing on identification of variable stars. Users will also be able to use developed tools for analysis of other data, both coming from GLORIA network telescopes and from external sources. In particular, telescope owners should be able too use GLORIA tools for analysis of their own data.

  For each experiment in the presented list users are able to access a detailed description, as well as to browse sample results. Some experiments (or some of their functionality, e.g. those requiring long computing time) can be restricted to more experienced users (with sufficient karma).

2.2. Available offline experiments

Both demonstrator experiments implemented so far are based on interactive image browsing and analysis by users, based on dedicated web tools.

2.2.1. Transit of Venus data

When browsing transit images taken in Cairns (Australia) and Sapporo (Japan) users point to the position of Venus, selected sunspots and the Sun's centre. Based on these data, coming from simultaneous observations at the two locations the distance to the Sun is calculated. The whole procedure is done within the browser window.

However, user can also decide to download images and analyse them locally, on their own computer, with local image manipulation software. By combining multiple images users can then extract lengths of the Venus trajectories on the Sun surface, as visible from two locations. These measurements, submitted to the GLORIA server via the web interface, will again result in the determination of the Sun-Earth distance. The details of both methods are described in details in the documentation available on the web.

2.2.2. Planet-tracking experiment

Users are able to browse all-sky images of the night-sky, taken at subsequent days. The users are encouraged to mark any moving, bright objects to help identify planets. This requires some training but is in principle very simple. With a whole-sky camera, planets look like a bright stars. One can hardly recognize them on single picture (if not compared with the sky chart). However, their position changes from night to night – that is why they were called "wandering stars".

After identifying a bright object, users mark their location in order to follow their relative position on subsequent images. Further marks can be placed down to note positions at different times, producing a trail of dots from night-to-night. After image analysis is finished, the planet's trajectory is seen relative to the trajectory of any other marked object - for example a nearby bright star. This simple tool allows one to realize that planet movement on the sky is non-uniform, often also not linear, in relation to the stars themselves.

Screenshots of this interface in action are included below. This experiment has been developed as a Liferay iFrame web component and as such is also accessible as an embeddable, standalone website at:

http://gloria-dev.s3-website-us-east-1.amazonaws.com/skydraw/index.html

A set of all-sky data selected to be used with the planet tracking experiment was made available by a BOOTES group. The high resolution all-sky camera COLORES takes an image approximately every minute and all of this data is archived. For planet tracking images were selected so that the stars would not move when changing the image (i.e. the condition of equal sidereal time) and so that the planet would culminate at midnight when in opposition. These images may be used to create video where stars are stationary and planets move between images, their identification is therefore very simple. The first data to be used contain Mars from the first half of 2012.

The BOOTES all-sky data were taken by the CASANDRA cameras at the BOOTES-1 and -2 stations. Each image is the result of a 40s exposure of the celestial sphere taken in South Spain, as part of continuous recording of the night sky since 2001, when weather conditions allows to do so. Limiting magnitude is typically 8 (or fainter, depending of the Moon conditions) so all the Solar Systems Planets are recorded on the frames. The original 33 MB fits formats have been converted into JPEG files for his proper analysis for the proposed GLORIA off-line experiment.

Figure 1: Tracking Jupiter in relation to Aldebaran, in Taurus. December 2012.

2.2.3. Atmosphere-cooling during Solar eclipse experiment

Although literally not an astronomical measurement, off-line experiment based on data taken during the Solar eclipse in November 2012 is a good example how new web technologies allow GLORIA to build interactive and rich web-tools. The interface is available at:

http://gloria-project.eu/eclipse-meteo/

Users can measure time delay between the maximum of the eclipse and minimum of the air temperature. Results of all measurements are stored in a database and visible to all participants.

3. Plans

Research level demonstrator off-line experiment, based on the Pi of the Sky data should be made available to users by end of February. Users will first select an object in the sky (within the predefined field, for which dedicated data were collected). Then, the light curve of that object will be reconstructed from the stored Pi of the

Sky images (using dedicated analysis server) and displayed in the browser. User will be able to analyse the lightcurve and, in case of variable objects, determine variability period and variability type. Different classes of variable stars will be available as predefined targets.

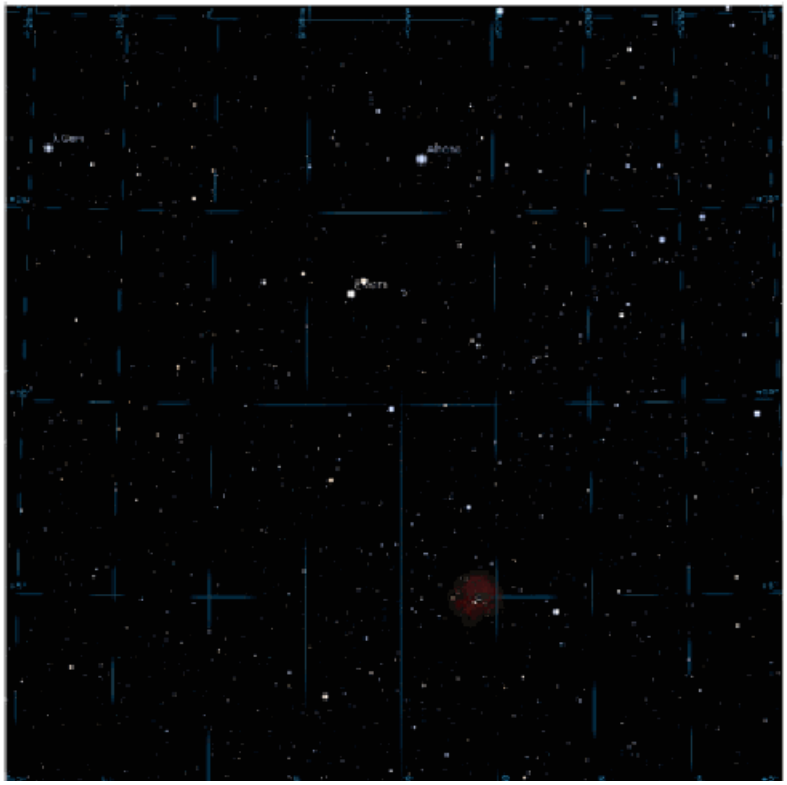

Figure 2: One of the fields from the Pi of the Sky observation archive, selected for the off-line experiment (sky map from the Stellarium program)

For this type of off-line experiments, which are based on analysis of large image samples, dedicated LUIZA analysis framework has been developed. LUIZA stores FITS images internally as the so called "collections". Each collection has a unique name, which can be used to access its elements. Data analysis is divided into small, well defined steps, implemented as so called processors. User specifies type and order of active processors, and their parameters, via the XML steering file, which is generated automatically from the web interface input. LUIZA passes the reference to collection storage to each processor in the data processing loop defined by steering file. Processors can analyse data already stored in memory, but can also add new collections (e.g. for saving analysis results). Output of the LUIZA job (e.g. light curve of selected object) is made available to the user via the web interface. Documentation of the LUIZA package is available online at:

http://hep.fuw.edu.pl/u/zarnecki/gloria/luiza/doc/html/index.html

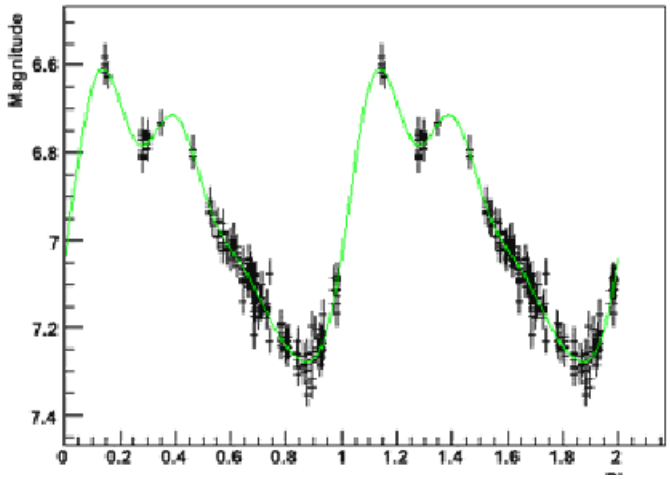

*Figure 3: Lightcurve reconstructed from Pi of the Sky archive data with LUIZA framework - example of classical Cepheid star V * W Gem*

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