

GLORIA in a Nutshell

GLORIA stands for "GLObal Robotic-telescope Intelligent Array". It is an innovative "citizen-science" network of robotic telescopes: 17 telescopes on 4 continents by the end of the project. It will be the first free and open access network of robotic telescopes in the world. The users will be able to do research in astronomy either through new observations with the available network telescopes, or by analyzing data that other users have acquired with GLORIA, and/or from other free access databases, such as the European Virtual Observatory.

The GLORIA project has two major objectives:

- ★ have a growing collection of robotic telescopes within the GLORIA network. This thanks mainly to the sharing of the produced software and the multimedia material.
- ★ allow everybody with an interest in astronomy, not only to professional astronomers, to contribute to or conduct their own scientific research projects.

<http://www.gloria-project.eu>

Benefits of the Network

Users who do not have telescopes in the network will have access to an arbitrary number of robotic telescopes via a web 2.0 environment.

During the three years of the project, at least 17 telescopes will be integrated into the network.

All the standards, software and documentation will be offered to the community under free licenses to use, distribute and modify (copyleft licenses).

Open Access

GLORIA project will define free standards, protocols and methodologies to allow citizen and professional scientists to integrate their telescopes and all related instrumentation (cameras, filter-wheels, domes, etc) into the network.

Alerts

An important aspect of GLORIA' operations will be the capabilities to respond autonomously to alerts on new transient sources discovery like supernovae and gamma-ray bursts. An alert program interface will be designed for the GLORIA's scheduler to allow the network to promptly responds to these events. The message carrying the observational request is sent to one or more participating robotic telescopes to optimize the follow-up observations by the network.



Global Scheduler

A variety of telescope schedulers already exist, mostly using genetics algorithms to find Pareto-optimal solutions (finding the single best solutions is considered at least NP-hard). However, they are *telescope* schedulers, not *network* schedulers. The "Intelligent" aspect of the GLORIA concept is based on taking the next step - providing a single scheduler that optimises the use of the network as a whole. GLORIA is not only a network of multiple telescopes, it is a network of heterogeneous telescopes, which also puts the project into a new territory. A proposed solution based on four parts is as follows:

- ★ Observing plan: a package containing everything the scheduler (and eventually a telescope) needs to know to carry out the observation
- ★ Telescope-independent scripting language for defining the sequence of steps of an observation
- ★ Authoring tool to create, store, recall and modify the observing plans, as well as submit them to the scheduler
- ★ The scheduler itself

GLORIA's scheduler accepts telescope-neutral Observing Plans as input, together with knowledge of the capabilities and the available time-slots of the network's telescopes. The output is a schedule of observations for each telescope according to the available time, and consisting of a sequence of Observing Blocks, which are Observing Plans converted to a telescope-specific form.

The most likely technical approach for implementing the scheduler is to take the scheduler from RTS2 (based on the NSGA-2 genetic algorithm) and adapt it for the extra degrees of freedom-multiple and heterogeneous instruments

<http://rts2.org>

Online Experiments

GLORIA provides the mechanism to allow the users to directly access and control the telescopes. Online experiments will be created and implemented by the GLORIA team, in addition web authoring tools will enable users to create their own online experiments.

When will the experiment be run?

- Fixed:** At a time chosen by the *user*
- Scheduled:** At a time chosen by the *system*
- Alert:** When triggered by an *external event*, eg a GRB

How will the experiment be carried out?

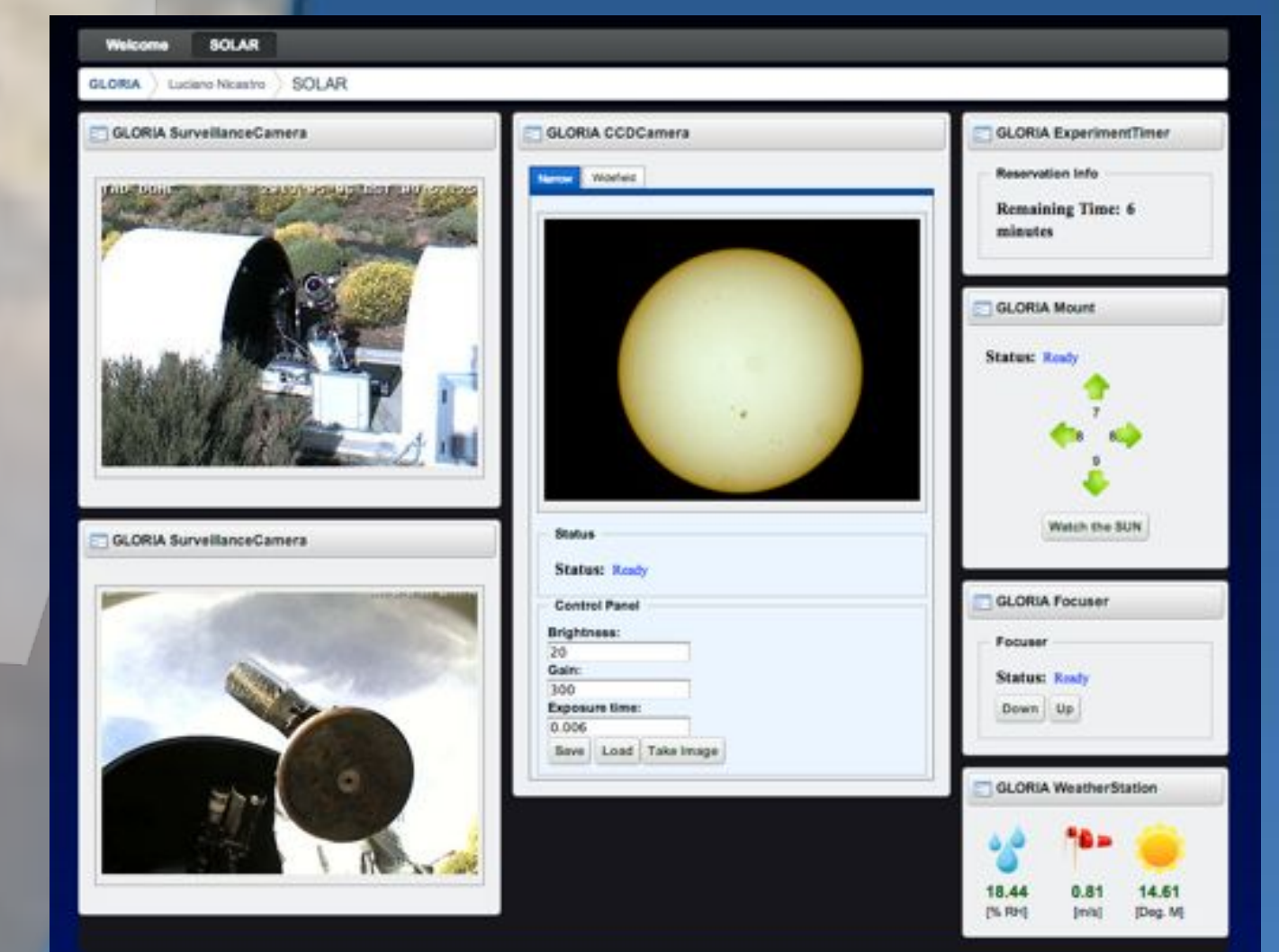
- Interactive:** Direct remote control of the telescope functions
- Batch:** The telescope receives a script, and executes it autonomously

Teleoperation

The direct remote control of a robotic telescope is achieved through the GLORIA developed Open Source software.

This direct operational mode is very useful to perform educational activities.

Below: Observing the Sun with the TAD-solar telescope in Tenerife.



users.gloria-project.eu/online-experiments

GLORIA

GLObal Robotic-telescopes Intelligent Array

E. Palazzi¹, L. Nicastro¹, P. G. Sprimont¹, M. Malaspina¹, M. Topinka²,
on behalf of GLORIA

1) INAF-IASF Bologna 2) University College Dublin

Outreach and Education

In order to raise awareness among the general public on GLORIA's capabilities and to generate interest in using the network, GLORIA is coordinating the live Web broadcasting of a number of astronomical events happening in the period 2012-2014.

In addition, educational materials, related to the broadcasted events and translated into the languages of the consortium, are being made available.

For example, all images of the Transit of Venus, taken from Sapporo, Japan and Cairns, Australia and Tromso, Norway, are freely available, and usable by students to measure the Sun-Earth distance.

Still to come:

- Total solar eclipse, November 3 2013
- Total lunar eclipse, April 15, 2014

Offline Experiments

This term refers to experiments in which GLORIA's archives, or other public databases, are used to carry out astronomical research, by professionals, amateurs and citizen scientists. There will be practical implementation of a number of such experiments during the project, for example:

- Classification of variable stars
- Evolution of variable stars over time
- Optical transient searches
- Occultations of stars by solar system objects

As for the online experiments, web authoring tools will enable users to create their own offline experiments.

GalaxyZoo is an example of successful citizen science project. Users are asked to classify galaxies from their shape.

Some Galaxy Zoo members are partners of the GLORIA project.

Citizen Science

GLORIA is a Citizen Science project which aims to take advantage of the collective intelligence of the Internet community.

Right now, users can contribute to the calculation of solar activity using the Wolf number. This can be done by obtaining and analysing images of the solar surface (photosphere) taken with the TADs telescope.



<http://galaxyzoo.org> <http://zooniverse.org>