

Title : will be set by the publisher
Editors : will be set by the publisher
EAS Publications Series, Vol. ?, 2012

GLORIA - the GLObal Robotic telescopes Intelligent Array for e-science

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Abstract. GLORIA stands for "GLObal Robotic-telescopes Intelligent Array". GLORIA will be the first free and open-access network of robotic telescopes of the world. It will be a Web 2.0 environment where users can do research in astronomy by observing with robotic telescopes, and/or analyzing data that other users have acquired with GLORIA, or from other free access databases, like the European Virtual Observatory.

1. Introduction.

Many Internet communities have already formed to speed-up scientific research, to collaborate in documenting something, or as social projects. Research in astronomy can only benefit from attracting many eyes to the sky - to detect something in the sky requires looking in the right place at the right moment. Our robotic telescopes can search the sky, but the vast quantities of data they produce are far greater than astronomers have time to analyze. Furthermore even the most advanced and powerful algorithms used in automatic analysis pipelines have limitations that could lead to missing important discoveries. GLORIA will provide a way of putting thousands of eyes and minds on the problem. It is intended to be a Web 2.0 structure, with the possibility of doing real experiments. The community will not only generate content, as in most Web 2.0, but will control telescopes around the world, both directly and via scheduled observations. The community will take decisions for the network and that will give "intelligence" to GLORIA, while the drudge work (such as drawing up telescope schedules that satisfy various constraints) will be done by dedicated algorithms that were developed for the purpose.

During the initial period, GLORIA consortium consists of 13 institutions, operating 17 telescopes which will be integrated into GLORIA network. Looking into the future, we plan to provide the needed material so other users could integrate their telescopes into the network. GLORIA is also collaborating with Discover the COSMOS EC funded project, which aims at innovative ways to involve teachers and students in eScience through the existing infrastructure.

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The GLORIA project will define free standards, protocols and methodology for:

1. Controlling Robotic Telescopes: and all related instrumentation like cameras, filter-wheels, domes, etc.
2. Giving Web access to the Network: access to an arbitrary number of robotic telescopes via a web portal.
3. Conducting On-line experiments: it will allow users to design specific web environments to control telescopes and perform observations aimed at studying some specific scientific issues.
4. Conducting Off-line experiments: users will be able to design specific web environments for analyzing astronomical meta – data produced by GLORIA and other databases.

We are going to seek the collaboration of amateur astronomers and their telescopes. Some amateur astronomers are very active, with excellent instrumentation and observing locations. However they are frequently limited in their ability to properly exploit and interpret their data. Interaction with professional astronomers and the use of powerful customized analysis tools will greatly improve the quantity, quality and reliability of the data that amateurs can collect with their instruments. GLORIA will profit from their telescopes, the data they produce, and simply the extra knowledge, experience and ideas their presence will bring.

GLORIA associates with each user a meritocratic parameter, called “Karma” in most Web 2.0 environments. This is correlated with the user's activity and their performance of useful work, and in the context of GLORIA, is how access to scarce resources (such as telescope time) is determined. Calculation of karma is done automatically via the votes of the community over the work of each user. This method has been successfully proven in many collaborative web sites such as YouTube, etc.



Fig. 1. Geographical location of 17 telescopes of GLORIA. A star symbol means multiple telescopes.

2. GLORIA as a network

Technically, GLORIA aims at creating a completely robotised, autonomous network of telescopes. For each target, the selection of instrument as well as exposure settings are to be decided automatically, without human intervention, based on information about telescopes and time slot which each telescope offers for the network. Putting together 17 telescopes in one network offers significant potential for automatically triggered follow-up observations. Such observations are obviously useful for transients of all kinds, including the GRB observations.

3. Experiments with GLORIA

GLORIA will provide a web interface that will allow users to perform specific astronomical researches through “experiments”. Users will be guided through the different tasks each research requires. These experiments are of two kinds: those that require a telescope (which we have called “on-line” experiments), and “off-line” experiments, which work on data produced by the GLORIA network or derived from other databases, such as the European Virtual Observatory. Moreover, GLORIA will design a methodology, documentation and software components to allow users to design new experiments. Advanced users will be able not only to design new experiments, but also to integrate them into the network, by following the open methodology, and make them usable by all.

During the lifetime of the GLORIA project, there will be demonstrators for at least one on-line and one off-line experiment. At an early stage of the project, the partners will decide on the exact astronomical topics to start investigating from issues such as: Exoplanets, Supernovae, Gravitational lenses, PHA (Potentially Hazardous Asteroids), Space debris, NEO (Near Earth Objects), etc.

4. Broadcasting astronomical events

To advertise the project and test P2P technologies GLORIA had set the goal to broadcast live 5 astronomical events around the world. Two such broadcasts, Venus Transit June 6th 2012, and Solar Eclipse November 13th 2012 have been successfully performed. Thanks to innovative P2P technology GLORIA network delivered images and video stream took in Japan and Australia live to more than 100 thousand viewers. In addition, some commercial TV stations took the GLORIA stream and broadcasted it on their channel. Dedicated pedagogical material had been prepared and distributed prior to each event and off-line experiments were created using data and images collected during the event. For further information visit gloria-project.eu.

Acknowledgements. GLObal Robotic telescopes Intelligent Array for e-Science (GLORIA) is a project funded by the European Union Seventh Framework Programme (FP7/2007-2012) under grant number 283783.