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Astronomical data reduction in DATA-GRID

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Abstract. The DRACO (Datagrid for Italian Research in Astrophysics and Coordination with the Virtual Observatory) project is meant to create a Grid distributed system of resources with multi-functionalities combined with the Virtual Obervatory approach. The final aim is the porting on DataGrid of all main astrophysical applications within a National calculation infrastructure. Partecipans to the DRACO project are the National Observatories of Rome, Trieste, Padua, Catania, Naples, Bologne and the University of study of Salern.
An astronomical software package has been developed to make all main astronomical tools availables on Data Grid (Astrosoft_v1.0Jan2005, Gallozzi et al., 2005, ref. http://grid006.mporzio.astro.it) starting from the ESO-Scisoft package.
This software package contains the ESO-MIDAS, IRAF, IDL, SEXTRACOTR, etc.
Here we present a standard astronomical data reduction test performed with the ESO MIDAS component of the Astrosoft package.
This data reduction test was submitted with a web Grid Portal developed within the same DRACO project. All tests and simulations were performed on the Gilda testbed.

Key words. DataGrid: data reduction – DataGrid: astrosoft – DataGrid: DRACO project – DataGrid: INAF DRACO Grid Web Portal –

1. Introduction

DRACO (Datagrid for Italian Research in Astrophysics and Coordination with the Virtual Observatory) is a concept aiming at providing the scientific community with a distributed multi-functional environment allowing the use of specialized (observational, computing, storage) Grid nodes. The astrophysical section of the project (work-package 10, coordinated by L.Benacchio/INAF-OAPd) is the implementation of three demonstrators whose goal is proving the feasibility of porting astrophysical applications within the framework of a national Grid infrastructure. DRACO provides the framework through which the Italian astrophysical community can participate in the international Virtual Observatory (VO) effort. A reference person (F.Pasian/INAF-OATs) has been nominated by INAF as its contact point for VO activities. The Final Goal of this project is to porting the astronomical applications to create an astronomical national framework of calculation. In particular, participation in the development of the Euro-VO project is envisaged. Partecipans to the DRACO project are the National Observatories of Rome, Trieste, Padua, Catania, Naples, Bologne and the University of study of Salern. An astronomical software package has been developed to make all main astronomical tools available on Data Grid (Astrosoft_v1.0Jan2005, Gallozzi et

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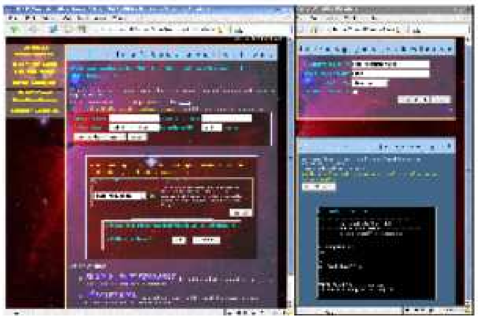

Fig. 1. This picture represents the INAF-DRACO test applications Section of the INAF DRACO Grid Web Portal. There are two main web pages: the first is on the left part of the figure which permits the choise of one of the simple test applications available on the Grid DRACO portal; the latter execute the submission, the monitoring of the scheduled job and the output retrieving for the completition of the job.

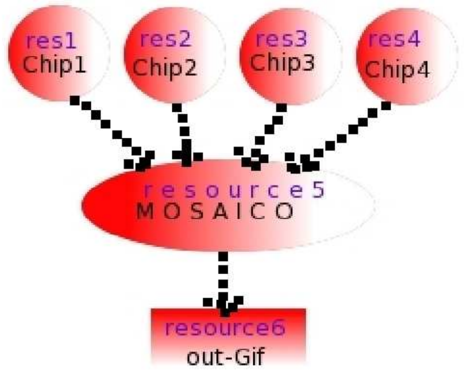

Fig. 2. This graph is the general workflow of the reduction test (or Directed Acyclic Graph of Job files). The starting four jobs are submitted in parallel mode to four free grid resources; only after the last completition of those jobs a fifth job is submitted to create a mosaic of the chip-reduced images. The last step is to produce a gif image from the fits mosaic image.

al., 2005, ref. http://grid006.mporzio.astro.it) from the ESO-Scisoft package. This software package contains a lot of astronomical application such as ESO-MIDAS, IRAF, IDL, SEXTRACOTR, ECLIPSE, SM, SWARP, etc. To test the right funcionalities of these softwares contained in the package we create some standard job submission scripts. Here we present a standard astronomical data reduction test performed with the ESO MIDAS component of the Astrosoft package. This data reduction test was submitted with a web Grid Portal developed within the same DRACO project to submit these tests more carefully and automatically. The main screenshot of this Grid-Web portal is shown in Fig. **??**. All tests and simulations were performed on the Gilda testbed.

2. Data Reduction Test Description

We created a standard test of astronomical data reduction for real astronomical images taken by the FORS1 instrument of the VLT telescope (NTT Deep Field). The workflow of the simulation is reproduced in the DAG picture (see Fig. 2). A DAG is an achronimum for Directed Acyclic Graph, which represents a collection of Job files (JDLs, Job Description Language Files) for each single operation to be performed on the Grid testbed.

As one can see from the Fig. 2 the four job reduction for each single scientific chips are submitted to be executed in parallel way on four different Grid resources. After the completition of these four jobs another job is performed to create the final reduced mosaic. Finally the last job is submitted to convert the fits resulted image into a general gif image of the reduced fits mosaic field.

The standard operations of astronomical data-reduction were performed on the astronomical raw images (raw+bias+flatfield) and the reduction operation was performed pixel by pixel with the following criteria:

Reduced_Chip = (FITSIMAGE_Chip - BIASIMAGE_Chip) / FLATFIELD_Chip

The four-chip reduced fits images are then coadded into a mosaic-reduced fits image of the global field. Two ESO-MIDAS routines were produced to perform such operations. The last step of the main DAG is the gif conversion from the reduced fits mosaic image, to take a look on the results of the mosaic creation (see Fig. 3).

The DataGrid approach for scientific problems of astronomical data-reduction results from this test very powerful and efficient, because of all the Grid infrastructure is efficient too. It is possible to make this first data-reduction test better and better to enhance its complexity according on the requirements of any astronomical instrument.

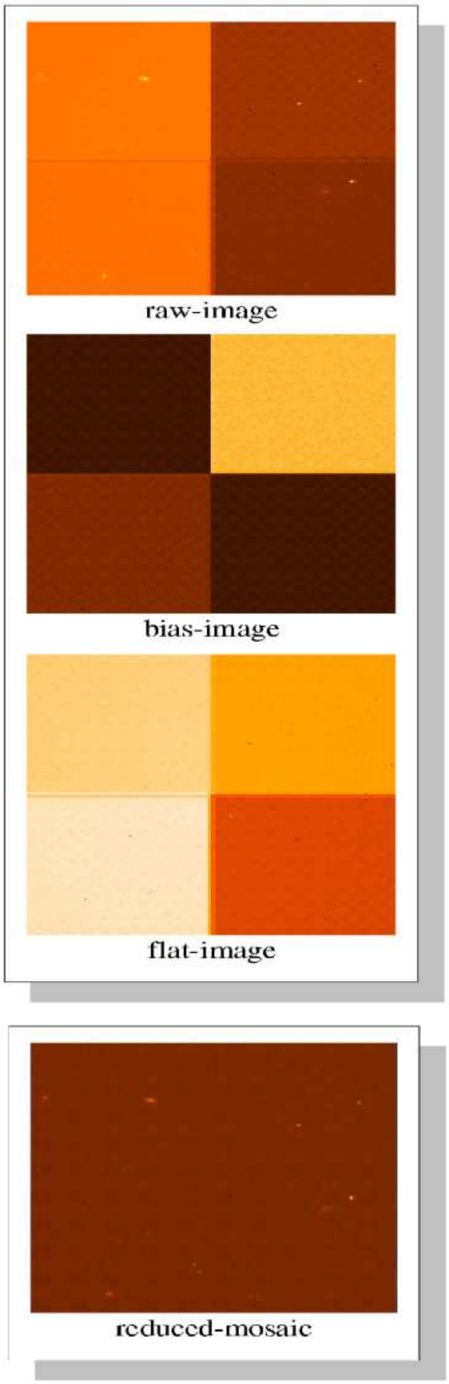

Fig. 3. These four images are the raw-fits image of the NTT Deep Field, the corresponding bias image and flat field image; the last image is the reduced mosaic created by the merging of the four single reduced chip images.

3. Conclusions

The possibility to use the DataGrid approach for the astronomical data reduction both for calculation and for the data-storage, makes easy to extend the astronomical data-reduction alghoritm for multi-chips instruments. This can be done submitting any single chip reduction step into a different DataGrid resource and retrieving only the output of the elaboration. This is what we have just done in our described astronomical data-reduction test.

It is also possible to add the features of a database approach for all submitted jobs, using the concept of Meta-Datas and Meta-Catalogues. In this way became easy to think to the global DataGrid Infrastructure as a huge DataArchive, DataHandling and DataManaging System for all scientific instruments.

Finally if we add the Virtual Observatory paradigm with the large use of IVOA standards, it is clear how DataGrid could make accessible all kind of astronomical data to all member of the international astronomical society even without a direct Grid connection: the only requirement is to develop some web services similar to our DRACO Grid Web Portal.

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