REFLEX
The ESO Recipe Flexible Execution Workbench

USING A WORKFLOW ENGINE FOR DATA REDUCTION

SAMPO

ABSTRACT

Sampo[1] is a three-year project that began in January 2005. It is led by ESO and conducted by a software development team from Finland as an in-kind contribution to Finland's joining ESO. The goal of the project is to assess the needs of the ESO community in the area of data reduction and analysis environments and to create pilot software products that illustrate critical steps along the road to a new system. Those prototypes will not only be used to validate concepts and understand requirements but will also be tools of immediate value for the community.

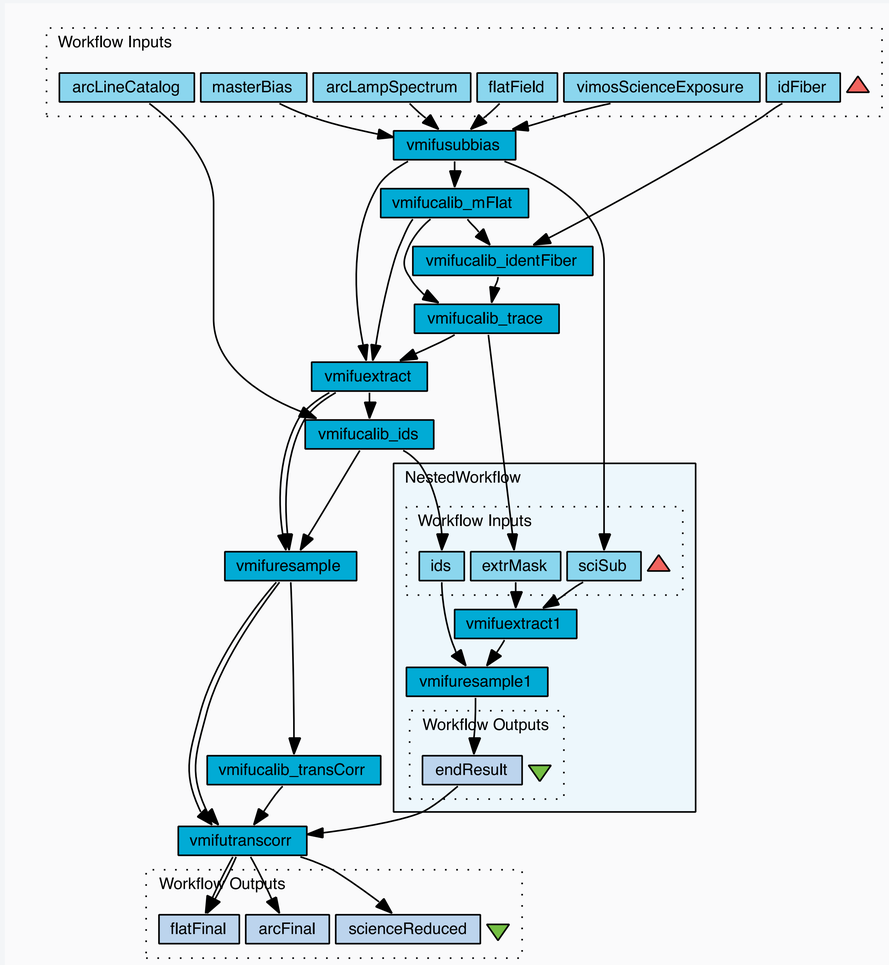
The Sampo team has been researching new ways in which instrument pipeline recipes can be executed in a more flexible way. The requirement gathering led to the development of an application called ESO Reflex[2], which offers a new approach to astronomical data reduction. The integration of a modern graphical user interface and robust legacy data reduction algorithms gives the astronomer the best of both worlds: ease of use combined with optimal scientific results.

THE WORKFLOW APPROACH

Much of the raw data produced by ESO instruments is reduced using CPL recipes. The CPL recipes are C programs following an ESO standard and utilizing routines provided by the Common Pipeline Library (CPL)[3]. Each of these recipes performs a single task in the reduction process and constitute the building blocks of the ESO pipelines. Until the introduction of ESO Reflex the recipes were run one at a time using a command line application EsoRex or a GUI-based application Gasgano.

ESO Reflex is based on the state-of-the-art graphical workflow engine Taverna[4]. It allows the user to define and execute a sequence of recipes with an easy-to-use and flexible GUI. Instead of running the recipes one at a time, a sequence of recipes can be run as a workflow where the output of a recipe is used as an input to another recipe. Workflows and sub-recipes have been created so far for two instruments on the ESO VLT - the IFU mode of VIMOS and the VLTI instrument AMBER.

The workflow defines the pipeline from raw data to reduced data. The users can either use the application to execute standard workflows provided by ESO or define workflows of their own. The standard workflows can also be easily modified to suit any particular needs the user might have. For example, extra visualisation steps or user-programmed scripts can be added to the processing flow. The workflow can also execute in parallel for more efficient computing on multi-processor or multi-core systems.



A data reduction workflow for ESO VLT (Very Large Telescope) VIMOS (Visible Multi-Object Spectrograph), IFU mode. ESO Reflex also supports the concept of "nested workflows" and one is shown in the figure.

ESO Reflex allows the user to execute the workflow either automatically or one step at a time. When running the workflow in a step-by-step manner, the user can make changes to the input data or parameters during the execution.

The data classification functionality offered by ESO Reflex helps the user to select the right data for input, which also reduces the likelihood of errors. ESO Reflex also detects errors that occur during the execution of the recipes, and appropriate action can then be taken by the user.

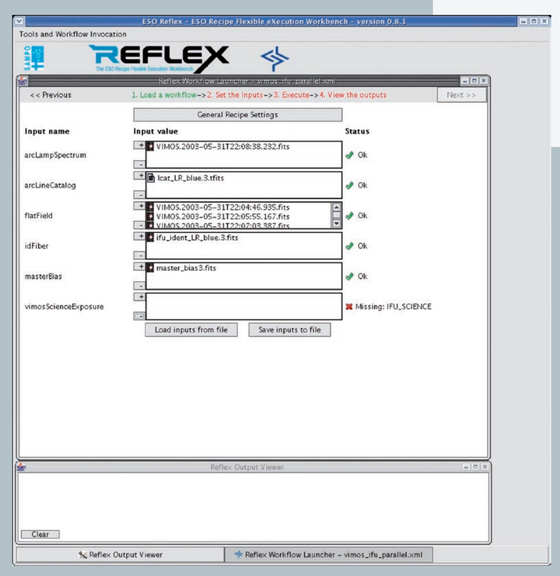
The Taverna workflow engine design assumes that many services would be remote rather than local and, as a result, it has comprehensive built-in support for web services. Future plans for Reflex include experiments that will use these facilities to access virtual observatory services from workflows.

TECHNICAL DETAILS

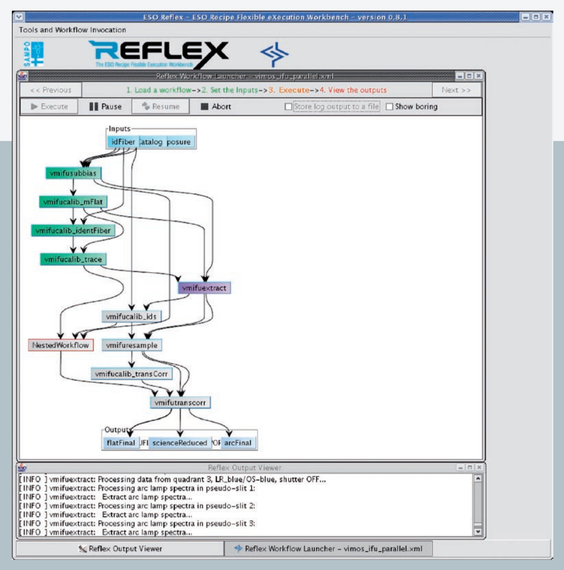
The ESO Reflex application is programmed in Java (version 1.5). The workflow creation and execution functionality is offered by Taverna, and some FITS file classification functionality is offered by Gasgano. ESO Reflex uses either JNI or EsoRex[5] to execute the CPL Recipes.

REFERENCES

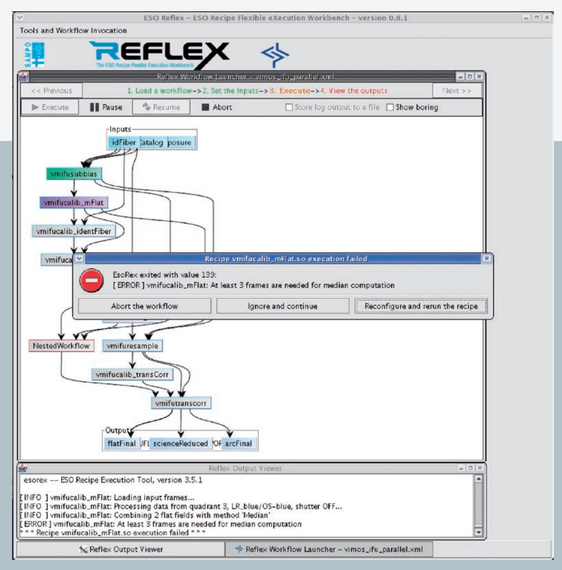
1 Sampo project: http://www.eso.org/sampo/
2 ESO Reflex: http://www.eso.org/sampo/reflex/
3 CPL: http://www.eso.org/observing/cpl/
4 Taverna: http://taverna.sourceforge.net/
5 EsoRex: http://www.eso.org/observing/cpl/esorex.html



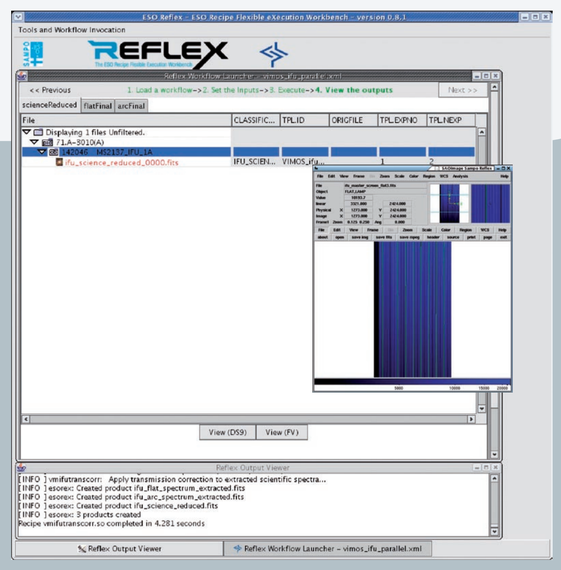
Data classification functionality



Workflow execution in progress



Error detection and recovery



Workflow output viewer

AUTHORS

Marko Ullgrén (Observatory, University of Helsinki)
Sami Maisala (Observatory, University of Helsinki)
Tero Oittinen (Observatory, University of Helsinki)
Otto Solin (Space Systems Finland Ltd)
Richard Hook (ESO)
Michèle Péron (ESO)
Martino Romaniello (ESO)
Tom Licha (ESO)
Carlo Izzo (ESO)
Ville Savolainen (CSC - Scientific Computing Ltd)
Pekka Järveläinen (CSC - Scientific Computing Ltd)
Johan Lindroos (CSC - Scientific Computing Ltd)

UNIVERSITY OF HELSINKI
SPACE SYSTEMS FINLAND
ESO
CSC