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VO-KOREL: A Fourier Disentangling Service of the Virtual Observatory

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Abstract. VO-KOREL is a web service exploiting the technology of the Virtual Observatory for providing astronomers with the intuitive graphical front-end and distributed computing back-end running the most recent version of the Fourier disentangling code KOREL.

The system integrates the ideas of the e-shop basket, conserving the privacy of every user by transfer encryption and access authentication, with features of laboratory notebook, allowing the easy housekeeping of both input parameters and final results, as well as it explores a newly emerging technology of cloud computing.

While the web-based front-end allows the user to submit data and parameter files, edit parameters, manage a job list, resubmit or cancel running jobs and mainly watching the text and graphical results of a disentangling process, the main part of the back-end is a simple job queue submission system executing in parallel multiple instances of the FORTRAN code KOREL. This may be easily extended for GRID-based deployment on massively parallel computing clusters.

The short introduction into underlying technologies is given, briefly mentioning advantages as well as bottlenecks of the design used.

Keywords. Methods: data analysis, techniques: spectroscopic, line:profiles, Virtual Observatory

1. Virtual Observatory

The Virtual observatory (hereafter VO) is a global infrastructure of distributed astronomical archives and data processing services enabling the standardized discovery and access to the astronomical data worldwide as well as a large set of powerful tools for scientific analysis and visualization (Solano 2006). VO supports mainly the multi-wavelength research or discovery of rare objects by cross-matching huge catalogues.

For interaction with the user as well as other computers, the VO uses the modern technology of Web Services (WS). The WS is typically a complex processing application using the web technology to transfer input data to the main processing back-end and the results (after intensive number crunching) back to user. All this can be done using only an ordinary web browser (and in principle the science may be done on the fast palmtop or advanced mobile phone). An example of WS is the e-shop or ticket reservation system.

2. Universal worker service

The Universal Worker Service — UWS (Harrison & Rixon 2010) is one of many standards of VO describing the exact operation patterns of WS supporting the execution of multiple jobs in an asynchronous way, allowing the simple control of jobs (e.g. changing their execution limits, timeouts and expiration) as well as easy access to the results using the web technology. The current version of UWS is based on a newly re-discovered RESTful technology (Fielding 2000).

The technology of WS allows us to provide the complicated computing code as a service running in the virtualized infrastructure of a large commercial provider or on a dedicated server of the software provider instead of providing only the source code. This idea has been promoted by the large IT companies under the terms of "Software as a service" and it is part of a wider business called *Cloud computing* (Foster *et al.* 2008). The advantages of this approach from the developer's point of view are clear:

- The only SW needed by the user is only a tiny web browser
- There is the only one, current, well tested version of the code (and documentation), maintained and updated often directly by its author
- The computing of various models may be controlled even from the smart mobile phone over a slow connection, as the large data are uploaded only once and most of the investigation requires only changing several numbers in a parameter file and re-submission of a job directly from web browser.
- The web technology provides an easy way of interaction (forms) and graphics output (in-line images)

3. VO-KOREL web service

The principal use of VO-KOREL is similar to e-shop portal, starting with user registration. Every set of input parameters creates a job, which may be run in parallel with others. The user may stop or remove them, can return to the previous versions etc. All user communication is encrypted and the user can see only his/her jobs. The service may be accessed from the KOREL portal at the Astronomical Institute in Ondřejov at address `http://stelweb.asu.cas.cz/vo-korel`.

The VO-KOREL web service requires the upload of the data file `korel.dat` and parameter file `korel.par` (and optionally the template(s) for template-restricted disentangling `korel.tmp`) in the format described in the KOREL manual (last chapters in Hadrava 2009).

Several sets (they may also be compressed in the form of a tar.gz file) can be uploaded to the server (within the disk quota allowed for the user) and the execution of the jobs may be postponed even until next login of the user. The user can decide on priorities about which jobs to compute, as the system can run only several jobs of every user; the others are queued until the computing resources (memory, CPU) are available.

4. Conclusions

The VO-KOREL service is not only providing a comfortable environment for Fourier disentangling of spectra, but it is a test-bed of the general cloud infrastructure for execution of most scientific computationally intensive codes, like models of stellar atmospheres or special processing of complex data sets.

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