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Planetary Science Research with the IMPEx Infrastructure

F. Topf (1), M. L. Khodachenko (1), E. J. Kallio (2), V. Génot (3), T. Al-Ubaidi (1), M. Gangloff (3), W. Schmidt (2), N. André (3), R. Modolo (4), S. Hess (4), I. I. Alexeev (5), and E. S. Belenkaya (5)
(1) Space Research Institute, Austrian Academy of Science, Graz, Austria (florian.topf@oeaw.ac.at / Fax: +43-316-4120-690), (2) Finnish Meteorological Institute, Helsinki, Finland, (3) IRAP, CNRS/Université Paul Sabatier, Toulouse, France, (4) LATMOS, CNRS/Université de Versailles Saint Quentin, Guyancourt, France, (5) Skobektsyn Institute of Nuclear Physics, Moscow State University, Moscow Russian Federation

Abstract

The EU-FP7 Project "Integrated Medium for Planetary Exploration" was established as a result of scientific collaboration between institutions across Europe and is working on the integration of a set of interactive data analysis and modelling tools in the field of space plasma physics. According to [1] these tools are comprised of AMDA, ClWeb and 3DView from the data analyis and visualisation sector as well as Hybrid/MHD and Paraboloid magnetospheric models from the simulation sector. The basic feature of IMPEx consists in connection of different data sources, including archived computational simulation results and observational data, in order to analyze and visualize scientific data by means of interactive web-based tools. These processes require a concrete definition of standards and interfaces which depends on the role each resource has in the overall infrastructure.

1. The IMPEx Infrastructure

The first step of establishing an integrated and distributed environment in IMPEx is dedicated to the classification of each participating resource. Within IMPEx there are three different types of services provided to the potential user: (see [2])

1. *computational services* which provide access to interactive simulation models,
2. *registry services* which provide searchable catalogues for observational and simulation data,
3. *data services* which represent the most fundamental type of resource, for example a service interface providing access to a specific observational dataset.

The standardization of those services ensure, that they can be composed and reused within service processes in the IMPEx infrastructure and other similar projects.

2. Science Case Methodology

Science Cases are providing the basement in the design of service processes within the IMPEx infrastructure. The main goal of establishing science cases is to provide information about the flow of data within a specific task to be executed by the IMPEx tools. This presentation will provide the results of the investigation around one major scientific objective: Studies of the magnetospheric environment around Venus and Mercury (see [3] and [4]). All participating tools and resources will be introduced as well as the types of data which are to be exchanged and processed. Each *Science Case* is representing a composed service activity which aggregates selected functionalities of the IMPEx tools.

3. Architectural Concepts of IMPEx

Based on the workflows elaborated with the Science Cases, all necessary components are identified which will assemble the architecture of IMPEx. The abstraction between the different types of services and their interconnection with state-of-the-art Web service technologies are in line with the definition of a "Virtual Observatory" by IVOA. The *computational services* and *data services* are to be described and deployed by using Web service interfaces so they can be accessed by all participating analysis tools. Additionally the *registry services* are to be designed for deploying XML documents providing metadata for the archived simulation runs of computational services. This presentation will show a selection of architectural concepts such as the implementation of a standardized messaging middleware with the SAMP protocol using the "Hub and Spoke" interaction pattern.

4. Summary and Conclusions

The currently ongoing architectural design phase of the IMPEx infrastructure has elaborated a selection of possible scenarios to interconnect tools like AMDA, ClWeb and 3DView as well as a set of simulation databases. The primary focus is on the reuse of existing Web services established by projects like EuroPlaNet and to take advantage of previous experiences made with the usage of IVOA standards. The principle definition of processes and tasks within the proposed research infrastructure with science cases enables the declaration of particular service activities needed to accomplish specific scientific problems. One of the most challenging issues within the proposed IMPEx architecture remains the handling of user related data, authorization and authentication in a coordinated way among all participating stand-alone tools, which may be subject of successive projects.

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