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PlanetServer – A web GIS and Python API for planetary hyperspectral images analysis

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1. Introduction

PlanetServer [1] is a web-accessible data visualisation and analysis system comprising different tools: a web Geographic Information System (GIS) and a Python Application Programming Interface (API) capable of visualizing and analyzing a wide variety of hyperspectral data from different planetary bodies.

2. System description

The service comprises a server and a client side. In the server side data are stored using the Array DataBase Management System (DBMS) Raster Data Manager (Rasdaman) [2]. Rasdaman offers features such as query languages, query optimization and parallelization on n-D arrays. Open Geospatial Consortium (OGC) standards such as the Web Coverage Processing Service (WCPS) [3], are implemented in the PetaScope component [4], a set of geospatial and geometry libraries, data access libraries and relational database access components. The web client is based on the JavaScript version of NASA's World Wind [5] a general-purpose 3D/4D client used as a virtual globe to interactively analyze and visualize data. The Python client API [6] provides the user the possibility to create RGB combinations within Python and embed the results in existing data analysis pipelines.

3. Data

PlanetServer contains three different types of data: Base maps and DTMs (for the webGIS) and hyperspectral images (for the Python API and WebGIS).

On Mars we have global Viking and colored Mars Orbiter Laser Altimeter (MOLA) as base maps, a MOLA DTM and Compact Reconaissance Imaging Spectrometer for Mars (CRISM) as hyperspectral images. For CRISM we serve Targeted Reduced Data Record (TRDR) and Multispectral Reduced Data Record (MRDR).

On the Moon we have Lunar Reconaissance Orbiter (LRO) Wide Angle Camera (WAC) mosaic and a colored Lunar Orbiter Laser Altimeter (LOLA) shaded relief as base maps, a LOLA DTM and Moon Mineralogical Mapper (M3) hyperspectral images.

4. Web GIS & Python API

PlanetServer's web client provides an easy and intuitive way to visualize and analyse hyperspectral images. It is composed by a 2D/3D globe where all data cubes are deployed and two main panels where different tools are available. The left panel contains the projections, base map selector, navigator and the RGB combinatory (pre-populated with CRISM products [7] translated into WCPS). In the right menu, the plot docks for single spectra retrieval, spectral ratio calculations and histogram stretching are located. Both plot docks can load the splib06a spectral library in order to pursue a first study of the CRISM spectra vs. laboratory spectra [8]. Results can be downloaded in different formats to be further analysed.

PlanetServer's Python API, integrates all the CRISM products mentioned in [7] and performs different RGB band math combinations. The API has three main parts: the band name and wavelength lookup table, the implementation of the CRISM summary products and the user input and output.

In order to make the API transferable, we created a lookup table linking the band names to their associated wavelengths. This allows us to use the API among different sensors. The main core of the API is the definition and translation of the CRISM summary products. We created a dictionary of summary products that the user can easily call in their RGB combinations. As the API is highly modular [12] this allows the user to define own summary products just by following the structure. Finally, the user can load one image and perform any RGB combination available in the API. Once the output image is shown, the user can collect spectra just by clicking on the desired location.

Planetserver is also exposed via the EuroPlanet Virtual Observatory System of VESPA [10, 11]

5. Summary and Conclusions

Results obtained using PlanetServer demonstrate that it is a reliable tool for the visualization, analysis of hyperspectral data, retrieval of spectra and band math combinations [7, 9].

As PlanetServer is highly modular, it can be easily integrated in existing pipelines in order to get access to science ready hyperspectral images. The combination of OGC standards, open-source server and client tools as well as openly available algorithms together with WCPS versions of hyperspectral formulas allows reproducibility of scientific observations and surface mapping.

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