Publishing Planetary Remote Sensing Data as OGC Web Services by Use of Open Source Software

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Introduction

We will demonstrate techniques to deliver HRSC and SRC image data as well as OMEGA footprint data based on standards defined by the *Open Geospatial Consortium (OGC)* [1]. OGC's service-based concept is a fundamental trend away from monolithic GIS systems towards distributed interoperable services. As many applications on the market are equipped with interfaces to *OGC's Web Services (OWS)*, plenty of tools are already available that can be applied to the data. By using open source software, we can focus our efforts on providing data instead focussing on developing and maintaining software.

Motivation

There are two interesting services defined by the OGC which are well suited for a prototype HRSC/OMEGA data delivery and application system.

The *Web Feature Service (WFS)* defines an interface for specifying requests for retrieving geographic features as vector data across the web. We will be evaluating this service for delivering footprints (geometric outlines of image data projected on the ground) of HRSC, SRC and OMEGA data combined with additional metadata.

The *Web Map Service (WMS)* interface standard provides a simple HTTP interface for requesting geo-registered map images from geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more geo-registered map images (returned as JPEG, PNG, etc) that can be displayed in a browser application. The interface also supports the ability to specify whether the returned images should be transparent (so that layers from multiple servers can be combined) or not. This service is evaluated for distributing the HRSC and SRC image data themselves.

OGC Compliant Footprint Database

As the amount of HRSC/SRC image data is rising during the further extension of the mission, there is a fundamental need for selecting, visualising and overlaying the ground footprints of the images. Speed, handling and extended capabilities are the reasons for using geo-databases to store and access these data types. Techniques for such a spatial database of image metadata are demonstrated using the Relational Database Management System (RDBMS) *PostgreSQL* [2], spatially enabled by the *PostGIS* extension [3]. PostGIS follows the OGC's *OpenGIS Simple Features Interface Standard (SFS)* as a well-defined and common way for applications to store and access feature data in relational or object-relational databases, so that the data can be used to support other applications through a common feature model, data store and information access interface. OpenGIS Simple Features are geospatial features described using vector data elements such as points, lines and polygons.

As an example, footprints of the HRSC/SRC and the OMEGA instruments are generated and connected to attribute information such as orbit name, ground- and image resolution, solar constellation and illumination conditions. The footprint and label of HRSC/SRC sequences are read out by the VICAR RTL developed at JPL, additional meta information is calculated using SPICE software routines [4]. This process is included in the automatic processing chain of HRSC images, so the footprint database is always up to date. OMEGA footprints and their attributes are generated using the IDL software provided by the OMEGA team. The data are then transferred into the database by PostgreSQL's *libq* C library using the *Well-Known Text (WKT)* notation for the geometry. PostgreSQL's advanced features such as geometry types, rules, operators and functions allow complex spatial queries and on-the-fly processing of data on DBMS level e. g. generalisation of the outlines.

Global Mosaics of Image Data

Adequate sequences of HRSC and SRC images are queried from the footprint database for each colour channel, are brought to a common mapscale (here exemplary 200 m per pixel) and are combined to mosaics by use of VICAR software routines developed at JPL and DLR. For the reason of speed and realtime availability, the planet's global surface is divided in to a limited number of tiles connected by a geometric index. These tiles are referenced on the planetary body using *world files* to make them accessible by spatially enabled applications.

Additionally, internal and external overviews are calculated, resulting in better display speeds for low resolution (global scale) as well as high resolution (image scale) map requests.

Delivery by MapServer

MapServer [5] is a popular open source project whose purpose is to display dynamic spatial maps over the Internet. It connects directly to the PostgreSQL/PostGIS footprint database and serves the data as WFS. To speed up drawing performance of the request call, a spatial (GiST) index is built for the feature table. For layer queries, an additional *object id (oid) index* should be established on the table.

Image data of HRSC and SRC are served as WMS. MapServer enables the creation of a network of Map Servers from which clients can build customised maps containing e. g. MOC, THEMIS and MOLA imagery (these data sets are already available as WMS). Definition of the Spatial Reference System (SRS) is made by the use of *OGP Surveying and Positioning Committee's EPSG* projection codes [6]. For extended support of planetary reference systems, the implementation of OGC's *Well Known Text (WKT)* notation of the coordinate system would be favourable. MS RFC 37 describes a mechanism to establish more flexible SRS definitions than the actual capabilities of MapServer [7].

This way, the planetary data sets can be made available for WMS-compliant mapping applications such as NASA World Wind (see figure 1) or Google Earth™.

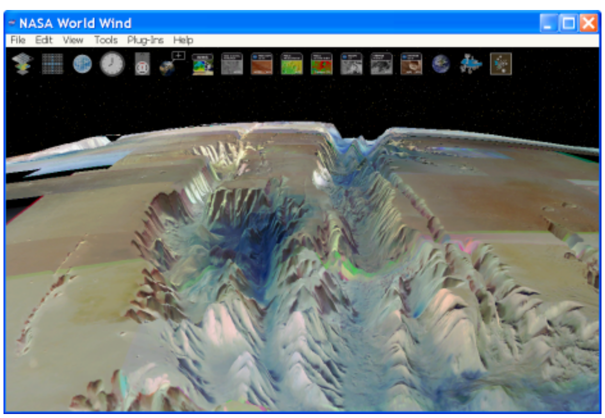

Figure 1: The *NASA World Wind* application allows online 3-D views of WMS-connected imagery

Outlook

The methods presented here are well suited for constructing OGC Web Services without the additional effort to develop and maintain software. A simple HRSC/OMEGA prototype application demonstrating footprint representation and orbit selection based on the open source *CartoWeb* framework [8] has been implemented (see figure 2). Being an integral part of the HRSC processing chain, the footprint database is always up to date. For an *officially* released WMS version of the HRSC/SRC images, the resolution should be adjusted to the best possible image resolution. For this to be achieved, the automated image mosaicking process must be improved and further performance considerations have to be made. WMS-served elevation information will lead to promising 3-D viewing applications of planetary data.

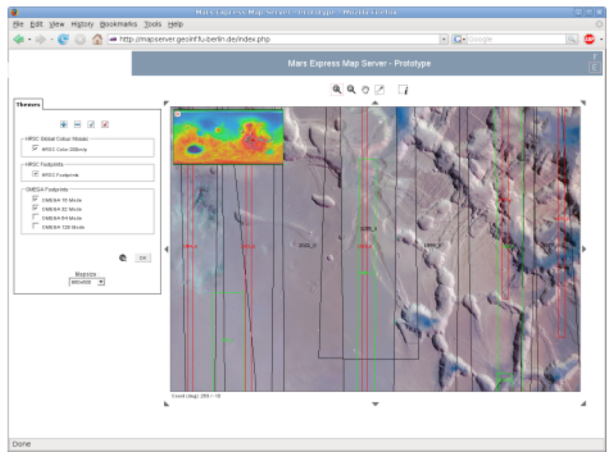

Figure 2: A simple prototype mapserver application based on the CartoWeb framework. The view shows HRSC and OMEGA footprint outlines on top of the HRSC image mosaic

References

[1] The Open Geospatial Consortium (OGC): http://www.opengeospatial.org

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[3] PostGIS extension for PostgreSQL: http://postgis.refractions.net/

[4] The NASA Planetary Science Division's Ancillary Information System (SPICE): http://naif.jpl.nasa.gov/naif/

[5] MapServer: http://mapserver.org/index.html

[6] OGP Surveying and Positioning Commitee: http://www.epsg.org

[7] MapServer Request for Comments No. 37: http://mapserver.org/development/rfc/ms-rfc-37

[8] CartoWeb Web-GIS and framework: http://www.cartoweb.org