Contribution ID : 165

A First Experience In Developing A Direct Readout System Using Open Source Web Gis Technologies.

Friday 15 Sep 2006 at 08:30 (00h30')

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Long abstract

1. Introduction

A first experience in developing a NOAA direct readout data management and
presentation system, using
both commercial and Open Source components is described. The direct readout system
is part of a ground
station which receives, pre-processes and archives data trasmitted by different
remote sensing satellites.
During its orbit and by means of its direct broadcast system, a satellite transmits
real-time data to any
ground station within its fied of view. The direct readout of satellite data is
performed by a system which
consists of the antenna and of the telemetry system for tracking satellite passes and
capturing raw data. After
the acquisition, a pre-processing sequence is activated, which converts raw data to
calibrated and geo-
referenced images.
Several commercial softwares are available to carry out the pre-processing phase and
to archive the
intermediate products to be utilized by geophysical scientists. Large scientific

organizations, like NASA,
NOAA, JPL, etc., have developed web based infrastructures which provide advanced services for searching,
viewing and accessing remote sensing products. Small scientific institutions are interested to develop low-
cost applications for data/product distribution with the aim to facilitate collaborative projects.
The objective of the system described in this paper is the development of a web application which will
improve access, viewing and retrieving of remotely sensed data; the system is linked to the direct readout
station already operative in our Institute. With major details, the functions we are going to implement are:

        -        automatic downloading of remotely sensed data acquired by our direct readout station;
post-processing of the downloaded product for converting it in a common data format and processing level;
        -        extraction of a standard set of information from the downloaded product (this will represent the
metadata related to the product itself) and its archiving;
        -        allow the user to search the data on the catalogue using a graphical interface and using geographic
search criteria;
        -        allow the user to navigate through quick looks in a GIS-like interface, with the possibility to add
administrative boundaries, towns, streets, points of interest, etc.;
        -        allow the user to download his final product.

2.The direct readout system

Aim of this work is to integrate a web application with a direct readout system set up to acquire AVHRR
images from NOAA-12, -15, -17 and -18 polar satellites passes. The direct readout system is a Seaspace [1]
Terascan TL200 station which collects data from polar satellites; it is composed of a 45 cm dish tracking
antenna, a receiver, a bit synchronizer and a Linux acquisition control workstation. The workstation hosts
Terascan software which makes passage acquisition scheduling, automatic pre-processing and image
manipulation (visualization, integration, etc.) by means of TeraVision stand alone desktop package. Terascan
works with a proprietary data format (Terascan Data Format - TDF) but the post-acquisition processing chain
can be configured to export the processeded images in different formats, among others, for instance, the
common format Hierarchical Data Format (HDF [2]).
In particular, Terascan was configured for: i) automatically acquiring all the passes of the satellite operative to
date; ii) registering the images in a standard window of 1200 x 1200 km, which include Italy and part of the
neighbour countries (central coordinate 42 1.29 N, longitudine 13 2.08 E); iii) projecting them in a UTM
reference; and iv) exporting the final product in HDF. Any area of interest inside the satellite pass can be
defined using a specific Terascan command (master) to be included in the pre-

processing scripts. The
acquired products are temporanery stored on the local file system in order to be
successively downloaded by
the web application.

3. The product classification system

Once acquired, the images are downloaded and classified on a workstation which
represents the Web/DBMS/
Application server in charge to host the developed software modules. The first module
of the application is in
charge of: i) the ingestion of the remotely sensed products; ii) the extraction of a
set of standard information
that will represent their metadata file; iii) the storage of these metadata in an ad-
hoc database; and iv) moving
the datasets in an appropriate location on the local file system. The developed
database and, in particular,
the metadata module, are designed following the recommendations provided by ISO
TC/211 standard [3],
package 19115-2. The set of information chosen to represent the metadata file
contains: product
identification and extension, data quality, platform and mission, spectral
properties, maintenance, spatial
representation, reference system and other general information. The database
management system (DBMS)
used to implement the archive is PostgreSQL [4] with the extension provided by
PostGIS module [5]. PostGIS
adds a powerful support to PostgreSQL in dealing with geographic objects, allowing
PostgreSQL to be used as
a backend spatial database for geographic information systems. A "spatial" addition
to the DBMS is needed as
our system must be able to manage data coming from different ground stations (thus
covering different
areas of Earth surface), so that users can perform queries using, for instance,
geographic criteria. Moreover,
as it will be discussed in the next section, the GIS enabling facility allows to
store into the database other
information, such as administrative boundaries, town locations, streets, etc.

4. The front end

The application interface includes several modules which allow users to search data
in the archive, to
immediately see the current daily product, to display and navigate the image quick
looks and, finally, to
download the selected ones. More in detail, the application was developed using PHP
(configured to work with
MapScript module [6]) and following a modular strategy and an object oriented
pattern, in order to allow an
easy extension of the prototype. In particular, the PHP MapScript module is a PHP
dynamically loadable
module that makes MapServer's MapScript functions and classes available in a PHP
environment. The map
server used is the University of Minnesota Mapserver [7] and for developing the
navigation interface we
started from GMap PHP/ MapScript demo application provided by the DM Solutions Group
[8].

The quick look visualization and navigation interface is developed using the above mentioned components
and allows the display of each AVHRR channel separately, and the dynamical addition of administrative
boundaries, towns, streets, etc. Besides, other canonical operations like zoom in/out, pan, restore, etc., are
allowed as well.

5. Conclusions and future developments.

This paper describes a preliminary experience in developing a web application prototype for remotely sensed
data archiving and management, using PostgreSQL with PostGIS, PHP with PHP MapScript and other free
software packages. The application works in conjunction with a commercial direct readout system by
extending its functions. This experience demonstrates the versatility of the mentioned Open Source
components in building different applications for Earth Observation systems. The application was in the test
phase for the last six months and has demonstrated to be stable and easily expandible. The planned future
developments will regard: i) a more complex infrastructure having the capability to manage data coming
from different remote sensing data sources; and ii) an automatic activation of the data processing chain, for
monitoring critical thresholds and providing an alert in case of possible critical situations. The Model View
Controller design pattern and Java technology will probably be adopted, in order to obtain a more efficient
maintenance and scalability of the infrastructure. The developed prototype is available at the URL: http://
oracolo.le.isac.cnr.it/mpcf/RS.

6. References

[1] SeaSpace Corporation. [http://www.seaspace.com]
[2] Hierarchical Data Format. [http://hdf.ncsa.uiuc.edu]
[3] ISO/TC 211 Geographic information/Geomatics. [http:// www.isotc211.org]
[4] Postgres SQL. [http://www.postgresql.org]
[5] PostGIS. [http://www.postgis.org]
[6] MapScript. [http://www.maptools.org/php_mapscript]
[7] MapServer. [http://mapserver.gis.umn.edu]
[8] DM Solutions Group. [http://www.dmsolutions.ca]

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Session classification : Session 16 : Organizational empowerment through Open GIS

Track classification : --not yet classified--

Type : Conference