Making Information Available to a Wide Array of Users

Automated Processing Chains for Sa

The Council for Scientific and Industrial Research (CSIR) Satellite Applications Centre (SAC), along with PCI Geomatics, has implemented an open integrated system for processing high volumes of satellite images in South Africa. It archives earth observation data and makes it available to the public.

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Union Buildings, Pretoria, South Africa. Image courtesy of DigitalGlobe

Recognizing the need for efficient and cost-effective automation and production systems within the geospatial industry, PCI Geomatics has introduced a series of solutions to address these requirements. These tools were selected by CSIR SAC for inclusion in fully automated preprocessing chains and enterprise-scaled automation for producing up to 100 satellite images a day.

CSIR SAC

CSIR SAC is the regional ground receiving station for Southern Africa. It provides world-class telemetry, tracking and command services, dissemination of low to high resolution satellite data, and the ability to archive earth observation data and make it available to the public. CSIR SAC acquires and receives satellite imagery such as Spot 2, 4 & 5, MODIS, ERS, Landsat 5 & NOAA, creating imagery products such as mosaics, orthophotos and land cover maps. CSIR SAC also supports and distributes Quickbird, EROS, Radarsat, ASTER, Formosat, and Ikonos. Support will also be offered for TerraSar X data after the launch this year.

The Earth Observation Service Centre (EOSC) at CSIR SAC handles the tasking, acquisition, processing, storage, application development and customer support for South Africa and abroad. Clients are able to access the EOSC service online catalogue providing them with the ability to perform constraint queries on data, upload areas of interest to refine queries, and visualize future acquisition opportunities where no data is currently available.

Situated in Hartebeeshoek along the Magaliesberg mountain range, CSIR SAC is an ideal location for satellite operation and satellite data acquisition. CSIR SAC also develops applications to address environmental issues such as land use management, fire forecasting and prediction, urban and rural planning and food security. CSIR SAC chose the PCI Geomatics solution brand, Geomatica X, which contains the company's software components used for building production workflows. Process chains have been created to automate steps such as DEM extraction, orthorectification, atmospheric correction and mosaicking to streamline their internal data process flows for the processing and classification of satellite imagery.

The Project Vision

CSIR SAC was approached by the government to assist with an implementation plan for the South African Earth Observation Strategy (SAEOS). The program would be in conjunction with a larger government initiative relating to information exchange amongst government departments. The project vision was to have a warehouse promoting accessibility of spatial information by all tiers of government and to avoid duplication of material.

The SAEOS is coordinating the collection, assimilation and dissemination of Earth Observation products. By making this information available to a wide array of users in an integrated and accessible form, this project is helping economic growth and sustainable development in South Africa.

Data Incompatibility

Spatial information for key decision makers is of crucial importance. Collecting, archiving and value-adding activities from source spatial data are disjointed, in different standards and lacking the correct metadata describing the product. Information provided to the end user is restricted due to the transfer of raster data over existing bandwidth without intelligent compression techniques. The outcome of the program was to establish a highly operational spatial gateway for government to address the data frustrations and to find a solution which would provide spatial information at a superior level.

The Architecture

Since the 1970s, CSIR SAC has been receiving telemetry from Earth Observation satellites. It thus has the unique operational experience to manage the remote sensing supply chain to a geo-processed product for analysis by the end-user community. With an archive of remote sensing data going back over 30 years, the centre has a valuable temporal dataset for analysis and change-detection applications. Created within CSIR SAC and disseminated to the government is the automation of national informa-

Workflow proces

tellite Imagery

Procedure	Processing Time
CDSPOT (import)	0:01:33
DEM Preparation (Pre-prepared)	0:00:00
Auto GCP Collection	0:02:15
GCP Refine	0:00:33
Panchromatic Orthorectified Image	0:09:35
Multi-spectral Orthorectified Image	0:11:25
Total Processing Time	0:24:41

tion layers derived out of remote sensing imagery. Such layers include land cover and classifications, road layers, field delineation and more. Being a large data-serving entity, CSIR SAC has a standardized and efficient processing chain to generate and manipulate data into products. Oracle 10g as a geospatial database is being implemented to complement standardization. Satellite telemetry is received at CSIR SAC through direct broadcast using the X band antennas. Satellite imagery is converted from telemetry, with the imagery stored in various raw computer-compatible formats on DLT tapes and archived in the SAC. The catalogue at SAC will soon transfer to GLOVIS, an open source Google-Earth-type applet used and developed by the U.S. Geological Survey.

High-level Software Functionality

Geomatica X consists of the PCI Geomatics Professional Software Development Kit (ProSDK) and groups of high-level functions that extend the ProSDK. Each group of functions, or ProPack, addresses a particular applications area. The functions themselves can be dynamically loaded by programs written in C++, Java, or Python on Windows or Linux platforms. Custom platform support is also offered.

These functions do not require operator interaction. Geomatica X users can incorporate PCI Geomatics' image processing, photogrammetry, and data-management software into their own interactive or fully automated applications. The data-management capabilities include writing and reading image and vector data to and from an Oracle 10g database. Geomatica X extends the PCI Geomatics image-centric desktop technology into custom geospatial solutions.

A Fully Automated Process

CSIR SAC used the Geomatica X product to develop a fully automated processing chain called SARMES to process Level 1 satellite image data into Level 3 and 4 data products. These data products are radiometrically and geometrically corrected and directly support advanced mapping and information gathering for applications such as agricultural change monitoring, emergency response, and disaster management.

An example of a SARMES workflow using Geomatica X for a Spot 5 level 1 dataset provides the following processing metrics, based upon a Windows XP Single CPU 3.4GHz Pentium processor with 2GB RAM.

The processing chain imports satellite imagery from raw format, extracts ephemeris data and calibration parameters, and computes ground control points from reference data. Orthorectification can be performed using the Toutin Orbital model or the Rational Functions Math Model or via digital/analog aerial camera models. This workflow can also be configured to automatically atmospherically correct, pansharpen, mosaic and archive imagery and metadata to the Oracle 10g database using the Georaster loader and metadata mapper functions. The general accuracy of the automatic process chain is between 1 and 2 pixels.

Result... a Push-Button Workflow

The automated processing of geospatial data can be run around the clock, and data no longer needs to be manually transferred between the database and the production system: the end result is a push-button workflow. With PCI Geomatics' automation technology for enterprise solutions, CSIR SAC can produce quality and accurate geospatial products including DEMs, orthorectified imagery, and mosaics. CSIR SAC's automated SARMES workflow permits timelier spatial data information and greater accessibility by the end-user community. The rapid delivery of geospatial information is able to assist key decision makers at various levels of government and stimulate the African renaissance.

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