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Operational SAR Data Processing in GIS Environments for Rapid Disaster Mapping

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The use of SAR data has become increasingly popular in recent years and in a wide array of industries. Having access to SAR can be highly important and critical especially for public safety. Updating a GIS with contemporary information from SAR data allows to deliver a reliable set of geospatial information to advance civilian operations, e.g. search and rescue missions. SAR imaging offers the great advantage, over its optical counterparts, of not being affected by darkness, meteorological conditions such as clouds, fog, etc., or smoke and dust, frequently associated with disaster zones.

In this paper we present the operational processing of SAR data within a GIS environment for rapid disaster mapping.

For this technique we integrated the SARscape modules for ENVI with ArcGIS®, eliminating the need to switch between software packages. Thereby the premier algorithms for SAR image analysis can be directly accessed from ArcGIS desktop and server environments. They allow processing and analyzing SAR data in almost real time and with minimum user interaction.

This is exemplified by the November 2010 flash flood in the Veneto region, Italy. The Bacchiglione River burst its banks on Nov. 2nd after two days of heavy rainfall throughout the northern Italian region. The community of Bovolenta, 22 km SSE of Padova, was covered by several meters of water. People were requested to stay in their homes; several roads, highways sections and railroads had to be closed.

The extent of this flooding is documented by a series of Cosmo-SkyMed acquisitions with a GSD of 2.5 m (StripMap mode). Cosmo-SkyMed is a constellation of four Earth observation satellites, allowing a very frequent coverage, which enables monitoring using a very high temporal resolution.

This data is processed in ArcGIS using a single-sensor, multi-mode, multi-temporal approach consisting of 3 steps:
(1) The single images are filtered with a Gamma DE-MAP filter. (2) The filtered images are geocoded using a reference DEM without the need of ground control points. This step includes radiometric calibration. (3) A subsequent change detection analysis generates the final map showing the extent of the flash flood on Nov. 5th 2010.

The underlying algorithms are provided by three different sources: Geocoding & radiometric calibration (2) is a standard functionality from the commercial SARscape Toolbox for ArcGIS. This toolbox is extended by the filter tool (1), which is called from the SARscape modules in ENVI. The change detection analysis (3) is based on ENVI processing routines and scripted with IDL. (2) and (3) are integrated with ArcGIS using a predefined Python interface.

These 3 processing steps are combined using the ArcGIS ModelBuilder to create a new model for rapid disaster mapping in ArcGIS, based on SAR data. Moreover, this model can be dissolved from its desktop environment and published to users across the ArcGIS Server enterprise.

Thus disaster zones, e.g. after severe flooding, can be automatically identified and mapped to support local task forces - using an operational workflow for SAR image analysis, which can be executed by the responsible operators without SAR expert knowledge.