

NGA Employs Emerging Commercial Space Radars

By THOMAS A.

As growing numbers of commercial space radar satellites deliver new data to countries around the world, NGA analysts and scientists are beginning to use these commercial systems to advance geospatial intelligence. In December 2009, the agency awarded three contracts for commercial satellite synthetic aperture radar imagery, data products and direct downlink services.

Access to these sensors improves NGA's ability to provide intelligence in low-light and bad weather conditions. Radar is an all-weather capability, making it extremely reliable and consistent.

Commercial Space Radar Imaging Improvements

The pace of development in the international commercial radar world has dramatically increased. From June 2007 through June 2010, six international commercial radar imaging satellites were launched. Italy launched three of its four-vehicle COSMO-SkyMed constellation, Canada launched RADARSAT-2 and Germany launched its TerraSAR-X and TanDEM-X satellites.

The Italian, Canadian and German commercial radars named above represent a significant improvement over previous commercial radar systems in that they provide images with resolutions as good as 1 meter and employ a special collection method that can vary the polarization of the energy that their sensors transmit to the ground. This permits them to collect images in different polarizations simultaneously and characterize the surface structure in interesting new ways.

The word "radar" is derived from the term "radio detection and ranging." Radar imaging systems emit microwave radio signals that are reflected from Earth's surface and returned to the sensor. The radar measures the parameters of the reflected waves, which are processed into images and other radar products. Many characteristics of radar images are based on the wavelength and polarization (orientation of the wave pattern) of the microwaves emitted from the sensor. Several combinations

of wavelengths and polarizations are available in radar imaging.

These new radars support large-area collection at medium and coarse resolutions, and they can collect pairs or series of images for use in change detection and other specialized applications such as measuring very subtle changes and shifts in land surface structure. Finally, each vendor offers direct downlink services for fast regional support.

Overview of the New Radars

Italian COSMO-SkyMed

The COSMO-SkyMed system has three operating satellites, launched between June 2007 and October 2008. Of the three new commercial space radar systems, it provides the highest collection capacity and fastest access to any ground area. This multi-satellite constellation has the shortest time periods between so-called "coherent pairs" of images that are collected at different times from identical locations in space and used for change detection applications. COSMO also has the best native resolution of the three commercial systems. The resolution for commercial customers is limited to 1 meter.

The Italians will soon complete the full four-vehicle COSMO-SkyMed constellation. They are also working with Argentina to possibly launch an L-band (long wave) radar constellation called SAOCOM. Such a system would be well-suited to applications measuring small elevation changes in land surface and would also provide some foliage penetration capability.

Canadian RADARSAT-2

Launched in December 2007, RADARSAT-2 is an improvement to the very successful RADARSAT-1 vehicle that pioneered commercial space radar imaging and has been operating reliably for nearly 15 years. RADARSAT-2 is capable of imaging extremely wide swaths, as large as 500 km. Of the set of new space radars, it has the longest collection time per orbit and is the only quad-



polarimetric sensor. RADARSAT-2 is expected to excel in ocean surveillance applications. Its best resolution mode is 1 meter by 3 meters.

The Canadian Space Agency has funded a RADARSAT-2 follow-on program called the RADARSAT Constellation Mission, which may include three to six satellites.

German TerraSAR-X

TerraSAR-X may be the most geometrically accurate commercial radar system. NGA's commercial imagery program recently evaluated TerraSAR-X accuracy to be 1 meter or better, when ground elevations are known. This performance is possible because of the very accurate orbit determination program that the Germans use to enhance the raw radar measurements.

On June 21, 2010, the Germans began a mission called TanDEM-X by launching a second radar vehicle to fly in formation with the first TerraSAR-X launched in June 2007. This is similar to the NASA-NGA Shuttle Radar Topography Mission, which flew on board the space shuttle Endeavor for 11 days in 2000, except that it will be a multiyear project and will generate global high-resolution elevation data that is more accurate and almost 10 times more dense than the best SRTM data. The Germans are also making plans for a TerraSAR-X 2 vehicle, which will be a commercial system with better resolution.

The Utility of Commercial Space Radar

These commercial systems offer unique space-based imaging opportunities. Taken together they are a constellation with daily access to locations virtually anywhere on the Earth's surface. The systems can meet the swift demands of many GEOINT needs, including environmental and disaster support. They are particularly useful during hurricanes and volcanic eruptions when other sensors are blocked by clouds and dust particles.

These three international space radar systems have significantly improved the resolution, collection capacity and other advanced radar imaging methods available from commercial sensors. NGA finds value in these sensors because they provide unique GEOINT support to national security missions. **P**

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