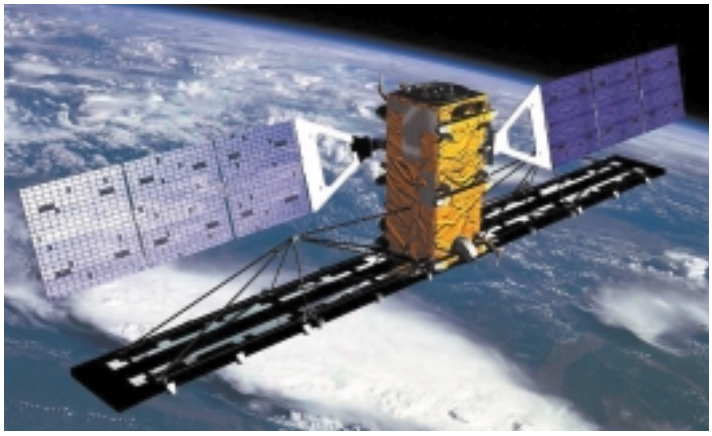
RADARSAT-2 GMTI Project

Space-based Radar Tracks Ground Movement

When a recent news headline called a DRDC experiment "Canada's plan for a super spy in the sky," some in the Department wondered out loud if it wasn't a bit of an overstatement. "No doubt the GMTI experiment we are working on holds significant potential," states Defence R&D Canada scientist Chuck Livingstone in his characteristically modest way "but there's still plenty of ground to cover before it's used operationally."



This is a conceptual image of RADARSAT 2 (with SAR Antenna at bottom), the technology that has been stirring imaginations with possibilities for new applications based on experiments involving capabilities for tracking movement on the earth's surface.

PHOTO: CDN SPACE AGENCY

In fact, RADARSAT-2 has been designed as a commercial Synthetic Aperture Radar (SAR) imaging satellite. In addition to its routine, radar imaging ability (which will be broadly used for sea-ice monitoring and shipping support, monitoring agricultural activities, forestry, geological and hydrological measurements, and disaster management), the satellite can also be operated in an experimental mode to detect and measure moving objects on the earth's surface.

Known as the Ground Moving Target Indicator, it isn't surprising that GMTI has managed to attract its fair share of attention. That's because the work being carried out by Canadian defence scientists as part of this $20M experiment may provide the means to monitor, from space, suspicious movements anywhere across Canada or elsewhere in the world, day or night, and regardless of environmental conditions. And, even though Hollywood films have already depicted this technology as available, those well versed in detection and tracking know that such real-life claims are premature.

"We now have the means to quickly detect and pinpoint movement on the earth's surface," adds Dr. Livingstone. "The radar carried on the RADARSAT-2 satellite can be configured to act as two radars that are used to measure the world from the same point in space, but with a shift of 1/1000 second. Changes in position of objects on the earth by fractions of a radar wavelength (approximately 1/36 wavelength or 1.6 mm for the satellite RADARSAT-2) can be measured by the radar. And where there's change, there's movement."

Spy satellites may be able to collect static images of metre-length objects, but they still don't have the means to detect movement and determine the speed and direction of vehicles over large areas. Current methods still require monitoring devices attached to the target vehicles, as in civilian company fleets being monitored as a business flow management system.

"Given Canada's vast and varied geography," adds Dr. Livingstone, "detecting and tracking terrorist or drug-related movements at sea and across our border is a huge, daunting challenge. GMTI focuses on objects that are not meant to be found."

Simulations have been used to scale the airborne measurement results to the RADARSAT-2, and have shown that the satellite should perform well for both military and civilian moving vehicle applications. Those results will be tested by experiment when RADARSAT-2 is launched in the fall of 2006.

Possible civilian applications of space-based moving object measurements include traffic monitoring in urban environments and improvements in traffic control designs for cities. To this end, the project is working with the Canadian Space Agency, with plans to collaborate with the German research institute, DLR, to combine moving object measurements from RADARSAT-2 and the German TerraSAR-X satellite (also due to launch in the fall of 2006) to investigate traffic monitoring.

"Can you detect the mover, and can you do so consistently? This is what the GMTI experiment is aiming to determine," says Mr. Livingstone.

On the military side, detecting a vehicle or ship via satellite, and knowing where it is headed and how rapidly, could allow Canada to observe many more vehicles headed to its borders in a manner that might represent considerable savings in time, energy and resources.

Once a target has been determined to represent a risk, this information is used to cue the navy, airforce, or public security agency for additional surveillance. Further investigation might include the use of manned or unmanned vehicles.

The RADARSAT-2 GMTI experimental mode, when complete, will provide some utility for the Canadian Forces over the life of the satellite. However, one of the primary objectives of the project is to define the radar and processing designs for a next generation GMTI space system. FL

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