FEATURES AND APPLICATIONS OF CANADAÂ€™S SECOND SAR SATELLITE

RADARSAT-2 To Be Launched in 2005

RADARSAT-2, Canadaâ€™s second Synthetic Aperture Radar (SAR) Earth observation satellite will offer users imaging flexibility and increased data information content, ensuring continuity of all existing RADARSAT-1 beam modes along with powerful new capabilities, from 3m resolution to flexibility in selection of polarisation. The satellite is due to be launched from Vandenberg Air Force Base in California in 2005.

RADARSAT-2 is Canadaâ€™s next-generation commercial Earth observation Synthetic Aperture Radar (SAR) satellite, the follow-on to RADARSAT-1, launched in 1995. The new satellite has been designed with significant and powerful technical advancements and provides the fulcrum of a programme representing a unique partnership between industry in the form of MacDonald, Dettwiler and Associates Ltd and government, the Canadian Space Agency. MDA will own and operate the satellite and ground segment, while the CSA is contributing funds for the construction and launch of the mission. The latter contribution represents an advance purchase of RADARSAT-2 data for use by the Canadian government. The RADARSAT-2 programme marks an important transition from the government-led RADARSAT-1 programme, to one now led by the private sector. RADARSAT International, an MDA company, is responsible for satellite-mission management operations and satellite programming, as well as international marketing and data distribution.

Features and Benefits

The RADARSAT-1 programme has become recognised as a reliable and timely source of information for a variety of applications, such as ship detection, emergency management, oil-seep monitoring, resource management, and ice mapping. It is the view of many researchers and business developers alike that the viability of SAR data as key intelligence for these and other applications will be strengthened with the launch of RADARSAT-2.

While RADARSAT-2 has many of the same capabilities as its predecessor, the new satellite has several notable design enhancements, offering unparalleled versatility in operations and imaging capabilities. The orbit parameters of the new system are the same as those of RADARSAT-1, allowing co-registration of images from both satellites. Radiometric and geometric data calibration will be the same for both satellites, allowing the use of both datasets for long-term data collection and comparison in change-detection programmes. Enhancements include choice of Vertical (V) and Horizontal (H) co-polarisation, cross-polarisation and quad-polarisation data, higher spatial resolution of 3m, left and right-looking imaging options, superior data storage and more precise measurements of spacecraft position and attitude.

Flexible Imaging Modes

The hallmark of the RADARSAT programme has been availability of user-selectable imaging modes offering a variety of incidence angles and resolutions that can be optimised to meet application-specific needs. In addition to its new Ultra-fine beam mode (3m resolution) and new polarisation options RADARSAT-2 will continue to offer RADARSAT-1 heritage beam modes and products. New to the RADARSAT programme are the variable polarisation modes, namely Selective Polarisation, Polarimetry (also called quad-polarised), and Selective Single Polarisation. The satellite is designed so that modifications can be made to programme custom beam modes when the satellite is in orbit. Thus new modes can be added, such as a 1m resolution â€˜spotlightâ€™ beam mode.

Moving Object Detection

RADARSAT-2 will also have an experimental research mode, used to demonstrate space-based ground moving target detection. The Moving Object Detection Experiment (MODEX) mode has been created under contract with Canadaâ€™s Department of National Defence. MODEX, or the more generic term â€˜along-track interferometryâ€™, is designed to detect, measure and monitor moving objects on the Earthâ€™s surface. By partitioning the SAR antenna into two sub-apertures aligned in the direction of flight, the satellite can image successive scenes. Comparison of the scenes reveals any spatial change during the intervening imaging time. The nominal minimum-detectable speed for moving targets, such as vehicles, is about 5m per second.

Polarimetric Datasets

RADARSAT-2 has the capability to send and receive radar waves in both Horizontal (H) and Vertical polarisation (V). This produces co-polarised signals (HH and VV) and cross-polarised signals (HV and VH). In contrast, RADARSAT-1 transmits and receives a radar wave that is horizontally polarised (HH). RADARSAT-2 will be the first commercial space-borne SAR satellite to offer quadrature polarisation (quad-pol) capabilities, producing fully polarimetric datasets. The radar system will transmit and receive all combinations of polarised waves simultaneously, producing an HH, HV, VV and VH dataset per image. Quad-pol data retains both the amplitude and phase information of the radar waves, and the relative phase between the channels is also measured. The differing and complementary information available from quad-pol improves both the ability to characterise physical properties of objects and retrieval of bio- or

geophysical properties of the Earthâ€™s surface. The polarimetric capability of RADARSAT-2 makes possible classification of surface characteristics from a single polarimetric image, reducing the need to conduct extensive ground-truth surveys. Such improvements in accuracy and automated classification for applications such as ship detection, crop-condition monitoring, oil-spill detection and geological mapping present exciting possibilities.

Orbit Information

RADARSAT-2 will be placed into the same orbit as RADARSAT-1, with an offset time of thirty minutes. This sun-synchronous orbit allows for near-continuous solar illumination of the solar panels, with the exception of the summer solstice. The satelliteâ€™s GPS receivers will improve the near-real time known position of the satellite and the geometric accuracy of fast-delivery products. More precise measurements of spacecraft attitude will be available through the use of star trackers.

Ground Segment Support

The ground segment of RADAR-SAT-2 has been designed to support a mission with greatly increased data volume. Large volume users will be able to place and track orders through a Web interface system. In addition, the time needed to plan an imaging request has been reduced, so that the time from order placement to command uplink to the satellite can be as little as four hours in the case of an emergency. Improved responsiveness of the ordering system includes near-real time conflict resolution and improved confidentiality. Another new feature of the ground segment is secure command uplink and data downlink; all data will be encrypted before being transmitted to a ground receiving station.
