

Dual Frequency Synthetic Aperture Radar Mission Concept

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Advances in spaceborne Synthetic Aperture Radar (SAR) remote sensing technology make it possible to acquire global-scale data sets that provide unique information about the Earth's continually changing surface characteristics. Short duration missions such as the Spaceborne Imaging Radar-C (SIR-C) and the Shuttle Radar Topography Mission (SRTM) have established the vast potential of SAR for expanding our knowledge of Earth. A long-duration (≥ 5 year) free-flying SAR mission would routinely provide valuable information about the dynamic characteristics of our planet. This paper describes such a mission concept, based on a dual frequency, polarimetric, interferometric SAR that has broad scientific, environmental preservation, operational, and commercial utility.

The system is uniquely capable of addressing a wide range of NASA Earth Science SAR measurement objectives such as surface deformation, environmental management objectives such as rapid oil spill response, operational objectives such as ice navigation, plus a broad range of commercial applications such as mapping, surveillance, forestry, agriculture, resource exploration, and land use and urban planning. A powerful feature that greatly reduces the potential for tasking conflicts between the numerous scientific, environmental, operational, and commercial observations is the instrument's ability to operate both frequencies independently and simultaneously.

The flight segment consists of a commercial spacecraft bus carrying an L and X band SAR instrument. The radar operating modes include high resolution (3 to 5 m ground resolution with swath width of 20 km for both L and X-band), dual and quad-polarization L-band modes with 25 m resolution and 50 km swath, ScanSAR (280 km and 500 km) and ultra-wide swath (900 km) ScanSAR for mapping large areas. Other system features include Global Positioning System (GPS) receivers to help provide precision orbit control to enable repeat pass interferometry for millimeter-level surface deformation measurement. The satellite is placed into an 800 km sun-synchronous polar orbit with a Delta-II launch vehicle. The nominal exact orbit repeat is 8 to 10 days, and the orbit is maintained in a 250 m tube to enable the required surface deformation measurement accuracy.

The ground segment and operations concept is based on a balance between leveraging existing capabilities and adding facilities with new features. Capitalizing on the demonstrated ability of SAR to differentiate oil on open water, the ground segment architecture has been tailored to provide unprecedented capability for rapid response to oil spills and other emergency management situations. The system provides an average time between observation opportunities of under 12 hours in most areas of interest, with over 95% probability of coverage in under 24 hours.

This globally preeminent SAR mission will be done in an innovative government-industry collaboration that is expected to contribute to the creation of new information industries, and has the potential to emulate the many examples of successful industrial segments initiated by government investment, such as the Internet, GPS and commercial space telecommunications.

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