



Mississippi State University

Screening of Levees by Synthetic Aperture Radar



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Prevent, Protect, Respond, Recover

Homeland Security Challenge:

The Homeland Security Presidential Directive of 7 May 2007 classified dams and levees as one of the 18 critical infrastructure and key resource sectors. The United States has over 100,000 miles of levees protecting cities, towns and property from damaging flood water. Many of these levees are aging and are in need of repair or replacement. The DHS Science and Technology (S&T) Directorate's Levee Strengthening and Damage Mitigation Program require the capability to identify potential problem zones along levees. This is consistent with one of the representative technology needs of the DHS S&T Directorate's Infrastructure Protection Integrated Product Team - i.e., provide early warning capabilities for early detection and notice of potential levee failures (DHS 2009). A cutting-edge systematic approach to levee condition assessment is hereby needed to provide levee managers with advanced screening tools to rapidly identify levee sections that have a potential for failure; and to identify, classify, and prioritize levee vulnerabilities as well as reduce the cost relative to traditional approaches.

Research Project Solution:

The objective of this research project is to develop pre-emptive screening techniques to identify levee sections that exhibit geotechnical or geologic characteristics that make the reach vulnerable to failure under flood loading. Once vulnerable breaches have been identified, further actions such as more detailed examination or repairs can be focused on these higher-priority sections. This research will facilitate levee screening by exploring the use of airborne radar as an input in the classification of levee condition. It will examine the applicability of other radar sources including both current and future satellite-based systems, and will also demonstrate a new and very efficient approach for taking in situ soil measurements for ground truth validation, verification, and calibration of the screening methods.

National Implications:

Recent incidents related to levees and dams validate the need to focus attention on the protection of these structures. The detrimental national impacts associated with levee failures are profound as shown by the tragedy of New Orleans during Hurricane Katrina in August 2005 and the flooding in Iowa and Illinois during June 2008. Additionally, recent dam failures in 2006 in Hawaii and Maryland further evidence the need to focus on dam safety. Improved knowledge of the status of dams and levees would significantly improve the allocation of resources to inspect, test, and repair the ones in most need. This research and development effort will result in new methods and tools for improving that knowledge, and will give these infrastructure managers new tools to prioritize their tasks.

RADARSAT-2



GSD (meters): 3 – 100
Swath (km): 70 – 500
Imaging Frequency: 5.405 GHz
Orbit: Sun-synchronous
Repeat Frequency: 24 days
X-Band Downlink 1: 8.105 GHz
X-Band Downlink 2: 8.230 GHz

Imaging Frequency
North of 70°: Daily
North of 48°: 4-days
The Earth: Every 6 days

Products:
Single Look Complex (SLC)
Path Image (SGF)
Path Image Plus (SGX)
Map Image (SSG)
Precision Map Image (SPG)



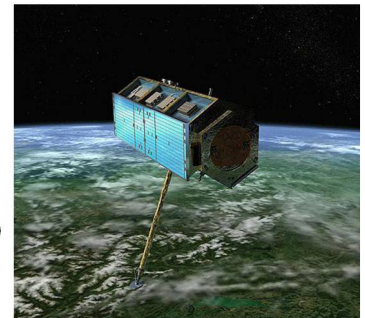
The Canadian Radarsat-2 Synthetic Aperture Radar satellite and its pertinent specifications.

TerraSAR-X

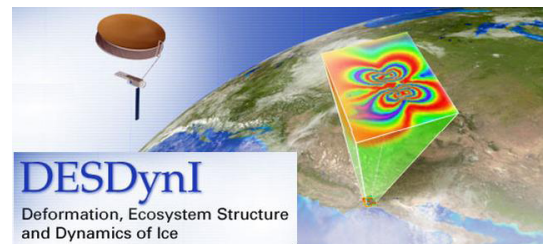


GSD (meters): 1 – 18
Swath (km): 10 – 100
Imaging Frequency: 9.65 GHz
Orbit: Sun-synchronous
Repeat Frequency: 11 days
Imaging Frequency: 2 – 4 days
X-Band Downlink: Two, frequency N/A

Products:
Single Look Slant Range Complex (SSC)
Multi Look Ground Range Detected (MGDR)
Geocoded Ellipsoid Corrected (GEC)
Enhanced Ellipsoid Corrected (EEC)



The German TerraSAR-X Synthetic Aperture Radar satellite and its pertinent specifications.



The NASA DESDynI mission concept (<http://desdyni.jpl.nasa.gov/>).

www.serri.org

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SERRI is managed by the Department of Energy's Oak Ridge National Laboratory for the U.S. Department of Homeland Security