Large Area Monitoring of Linear Infrastructure using RADARSAT-2

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Content

• Introduction
• SAR, Broad Area Change Detection, Land Surveillance
• RADARSAT-2 capability
  – Unique surveillance capability: XF image mode
  – Capacity and products
• Examples of Alert programs
  – Forest Monitoring
  – Hazards
• Alerts near Linear infrastructure
  – Hazards on or near infrastructure
  – Encroachment, human activity (persistent, random)
  – Deformation, subsidence
Spaceborne SAR, strengths for land monitoring

- Reliability of acquisition (99%)
- Consistency of change detection capability
- Efficiency and automation
- Deformation measurement
RADARSAT-2 XF (Extra Fine)
Large images (125 x 135 km), High resolution (5 m)

Very dense information!

Sample spacing: 2.66 m (sl.range) x 2.50 m (azimuth)
26784 samples x 54145 lines = 1.45 Billion pixels

<table>
<thead>
<tr>
<th></th>
<th>Inc. angle near edge</th>
<th>Inc. Angle far edge</th>
<th>Ground Resolution far edge (m)</th>
<th>Azimuth resolution (m)</th>
<th>Swath (km)</th>
<th>NESZ (dB)</th>
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Coverage and volumes of exact-repeat RADARSAT-2 5 m resolution archives (since 2011)

- Total archive coverage 1.33 B km²
- 359 M km² in 2016
- 30-40 M km² / month in 2016
- Stored in Canadian archive
Large Area Change Detection, Surveillance
Analogy between surveillance cameras and SAR imagery

• The problem of efficient, automatic use of optical images from space
• The opportunity for high resolution (better than 5 m) repeated SAR coverages
  – Identical illumination conditions
  – 100% reliability in obtaining the imagery
The challenge of forest monitoring using optical imagery

Hainan Island, China

December 27, 2009

Selective logging, difficult or impossible to detect

New cuts in plantation

November 18, 2010
RADARSAT: Automatic and effective forest monitoring (Hainan, China, December 26, 2009 – November 3, 2010)

New cuts in plantation

Selective logging outside plantation
Efficient Broad Area Surveillance for Defense Applications

Where to look? WV imagery collected on October 6, 2014

RADARSAT-2
2014-10-01

WV-02, 2014-08-08

WV-02, 2014-10-06
RADARSAT-2: “Tip and Cue”
For detailed analysis, inspection and enforcement

Illegal logging
Coca plantation activity
Illegal mining activity
Illegal logging
Brazil, Para Province, Xingu River Native Reserves
RADARSAT-2 Monitoring program Funai (Fundação Nacional do Indio)

- Illegal logging and encroachment into native reserves related to dam construction and associated economic activity
- Full XF coverage every 24 days
- Forest alert products
- Started early 2016
Indonesia (Sumatra, Kalimantan) Forest Concessions
Zero-Deforestation enforcement of Conservation Forest
RADARSAT-2 Forest Monitoring

- Program start October 2016
- 29 stacks (frames) repeated every 24 days
- First “Streaming” Forest alert service provided NRT (2 days after acquisition)
Disaster Damage assessment
Typhoon Morakot, Taiwan, August 5 2009
Landslide inventory and hazards analysis
Using RADARSAT-2, 5 m (August 16, 2009 vs. March 25, 2009)
InSAR deformation alerts: JingJin High Speed Rail (HSR) 
China (between Beijing and Tianjin)
Stable Reflections from the Rail Posts as visible in the SAR Imagery

Green: stable reflection in 5 scenes, usable for InSAR (CTM)
Subsidence Profile Along HSR

Maximum rates of approximately 10 cm per year

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Area A: Yizhuang Railway Station (at 21.3 km)
Significant Deformation Signal (~5 cm)
Conclusions

• Spaceborne SAR is an effective and efficient tool for land monitoring (sufficient resolution, swath width required).

• Opportunity for alert systems (e.g. in combination with EO imagery).

• Operational integration in user GIS environment