

Assessment of C,L,X-band Spaceborne SAR for Maritime Domain Awareness

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To meet requirements for operational maritime domain awareness, multiple spaceborne Synthetic Aperture Radars (SAR) are required to address re-visit. To address these needs, the use of C,X,L-band SAR for ship detection was investigated. The Radar Cross Section (RCS) frequency dependence of [1] was modified to include a ship-length dependence. The X-band RCS was about 1.3 dB greater than C-band, and C-band was about 2.8 dB greater than L-band. The ship RCS increased most rapidly for ships less than approximately 100 m, but leveled off as the ship length increased.

Ship detection performance was modelled using the ship/ocean RCS and wind speed/direction. The ocean RCS had a weak frequency dependency [2],[3], so CMOD4 was used. The results indicated the difference in the minimum detectable ship-length as a function of SAR frequency was the largest at small incidence angle, but converged with increasing incidence angle.

The modelled output was mapped to SAR imaging modes and orbit modelling software was used to assess spatial coverage. The results for an arbitrary 7-day period, based on RADARSAT-2, TerraSAR-X, and ALOS-2, indicated that daily re-visit was possible, with multiple daily re-visits occurring about every second day. From an end-user perspective, if SAR imaging modes are selected with due consideration for incidence angle, then multiple SAR sensors can be integrated to meet operational needs.

[1] Skolnik, M., An Empirical Formula for the Radar Cross Section of Ships , IEEE Trans., vol AES-10, March 1974.

[2] NRL, Sea-Clutter Measurements, Naval Research Lab, AD850069, July 1973.

[3] Vachon, P.W., English, R., Sandirasegaram, N., and Wolfe, J., Development of an X-band SAR ship detectability model. DRDC Ottawa TM 2013-120, Ottawa, 2013.