A NEW CONCEPT OF SPACEBORNE MARITIME SURVEILLANCE RADAR

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The surveillance of economic ocean zones and adjacent waters is growing in interest. On the sensor side, a mixture of active and passive sensors, and cooperative and non-cooperative techniques provide new opportunities for maritime surveillance.

Radar, which is an all-weather, day and night, and non-cooperative technique, appears as a key contributor for future maritime surveillance systems.

Ship detection with satellite based SAR was first demonstrated by the experimental Seasat in 1978. With later first-generation satellites such as ERS-1, JERS-1, ERS-2 and Radarsat-1, the field has reached some maturity. The second generation of radar satellites, ENVISAT (2002), Radarsat-2 (2005), ALOS (2004), have steerable beams, some polarization flexibility, and many imaging modes, several of which have some potential for operational ship detection. Radarsat-2 is best suited for wide-area (300 km) ship detection. ENVISAT has a significant capability in more narrow swaths (<100 km). The third generation satellites TerraSAR-X (2006), Cosmo-SkyMed (2006), SAR-Lupe (2005) are somewhat different, as the design is more heavily influenced by the requirement for high-resolution imagery on land. This introduces some limitations regarding maritime use, especially concerning the swath width, which is rather limited. The main elements affecting the ship detection capability of SAR instruments are : swath width, incidence angle, spatial resolution, number of looks, polarization, instrument noise floor, sea clutter level (or radar sensitivity).

However, conventional SAR instruments are not actually well adapted to maritime surveillance (i.e. ship detection) over wide areas. Their detection performances are by principle modest because of the speckled behaviour of radar targets and sea clutter that can not be sufficiently reduced with the low number of independent looks offered by this technique. The use of the ScanSAR technique for increasing the swath width further degrades the number of looks and consequently the detection performances in this mode. In addition, such instruments present a limited operation time over their orbit (20 minutes for best satellites i.e. 20% of the orbit) because of their very high power consumption and dissipation (several kilowatts).

The innovative concept that is proposed by Thales Alenia Space and that is presented in this paper mitigates the SAR technique limitations.

The concept is specifically oriented for ship detection, and not for land or sea imaging. It allows wide swath coverage (as high as 1000 km). It exhibits high detection performances of small ships even in adverse sea states conditions. It requires low power supply requirement allowing a permanent operation on the orbit. At least, it uses already developed and low cost technologies.

The paper that is proposed shall address the limitations of the SAR technique for ship detection in an operational context. It will present the innovative concept that allows a better satisfaction of mission requirements. The improvement given by the concept shall be quantified. An example of concept performances (swath width, detection probability, false alarm probability) shall be given. The proposed radar architecture shall be outlined, the main technologies described and the mass / power / data rate budgets given.