

EARTH OBSERVATION SYMPOSIUM (B1)
Earth Observation Applications and Economic Benefits (5)

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SPACEBORNE X- AND C-BAND SAR DATA EXPLOITATION FOR SHIP ROUTE ANALYSIS

Abstract

Exploitation of spaceborne SAR data is strongly improving maritime traffic safety, fishery control, and border surveillance [1]-[2]. Classic approaches for ship detection exploit various aspects of ship appearance in SAR images, but the analysis of their wakes, when imaged, is needed for a reliable and quantitative estimation of the route. In this ambit, the paper overcomes the thresholding approach [3]-[4] and shows a wake detection technique [5] in which wake features are only searched where they are expected to be, opportunely limiting the search area in terms of hydrodynamic theory. The algorithm core consists in a sequential procedure to identify the five potentially imaged wake structures of interest: the turbulent wake, the two narrow-V wakes and the two cusps of the Kelvin pattern. Then, merit indexes in the intensity domain are used to validate the detected linear features as real components of the ship wake. The algorithm has been applied [5] on 13 X-band SAR images from TerraSAR-X and COSMO/SkyMed mission with different polarization and incidence angles. Results have shown that no missed confirmation are obtained for turbulent and narrow-V wakes and have confirmed that the algorithm is robust with respect to critical situations, such as multiple wakes appearance or dark areas not related to wake features. It is also verified that the algorithm does not detect wakes in the surroundings of ships without wake appearances. With the aim to extend the algorithm applicability to C-band data and support its integration in an automatic procedure for ship traffic monitoring, the wake detection technique will be applied on Sentinel-1 data at different sea states. Finally, ship velocity will be estimated by wake-based techniques and the results will be validated with truth-at-sea (Automatic Identification System data).

[1] EMSA, 2010. EMSA 5-Year Strategy. <https://extranet.emsa.europa.eu/> [2] Council of the European Union, "Council conclusion on integration of Maritime Surveillance," General Affaris Council meeting, 2011. [3] G. Zilman et al., "The Speed and Beam of a Ship From Its Wake's SAR Images", IEEE Transactions on Geoscience and Remote Sensing, vol. 42, no. 10, pp. 23-43, October, 2004. [4] K. Eldhuset, "An automatic ship and ship wake detection system for spaceborne SAR images in coastal regions", IEEE Transactions on Geoscience and Remote Sensing, vol. 34, no. 4, pp. 1010-1019, July, 1996. [5] M.D. Graziano et al., "Wake component detection and validation in X-band SAR images for ship heading and velocity estimation", submitted on Remote Sensing – MDPI.