A Ship Wake Detectability Model and its Application to Wake Detection

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Abstract

The opportunity to use satellite-based SAR sensors for the monitoring of ship traffic has been researched extensively during the last decades. Most commercial ships are well visible on SAR images due to their excellent backscattering capabilities. However, the direct detection of any kind of maritime vessel is not possible, as non-metallic maritime objects made of materials like rubber or wood are nearly invisible on SAR images. The reason for this is the inherent property of SAR of being most sensible to the availability of conductive materials. Nevertheless, the anomalies on the imaged conductive sea surface structure induced by moving ships can be recognized. For this reason, the consideration of ship wake signatures for the monitoring of ship traffic is of importance. While most automatic ship detection methods search for strong backscattering on the SAR images to identify possible positions of ships, the automatic detection of the ship wake signatures is a more complicated task. Simultaneously to automatic ship detection in the recent decades also the detection of the signatures of ship wakes has been studied. Published approaches often apply Hough transform or image convolution by filter banks.

The executed study elaborates on the detectability of ship wake signatures on TerraSAR-X, RADARSAT-2 and Sentinel-1 images. A binary logistic regression classifier is applied to build a new data-driven detectability model. The classifier is used to calculate probabilities of the visibility wake signatures in the surroundings of verified positions of moving ships, by parameters describing environmental conditions, image acquisition settings and ship properties. As the parameters describing environmental conditions and image acquisition settings are available for each SAR images, the wake detectability model can be applied to control the sensibility of operator-based and automatic wake detection methods. Also drawbacks to the ship velocity can be estimated by reversing the model. An example application will be presented.

Similar to the wake detectability the detectability of ship signatures can be modelled. Such a data-driven approach for ship detectability is also presented and compared to the state-of-the-art simulation-based ship detectability model, which was developed by Vachon. For high and low resolution images the models show similar dependencies of ship detectability.