Dual polarimetric TanDEM-X for ship detection with a notch filter.

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The monitoring of coastlines is a major topic for security and surveillance. In this context, satellite remote sensing with Synthetic Aperture Radar (SAR) has proven to be particularly beneficial because of its capability to acquire images with any-weather conditions and at night time. In recent years, there has been a growing number of satellite borne SAR sensors that allow the possibility to attain the information related to the polarisation of the electromagnetic wave. Polarimetric information can be exploited to assist in the detection and classification of targets, since different targets are likely to exhibit different backscattering characteristics when illuminated by different polarisations. This work concerns ship detection exploiting dual- polarimetric SAR data acquired the TanDEM-X constellation. Specifically, a new algebraic representation of polarimetric targets is introduced and the algorithm performs a “perturbation analysis” in this vector space and measures the coherence between a target to detect and its perturbed version on the data. In order to adapt this approach to ship detection, the target to detect is defined as any vector lying in the orthogonal complement to the vector which represents the polarimetric signature of the sea. In other words, the algorithm can be considered to be a notch (negative) filter focused on the sea and all the features which have a polarimetric behavior different from the sea are detected (i.e. ships, icebergs, oil spills, etc). In order to make the algorithm applicable to any data and sea conditions the polarimetric signature of the sea (the Null) are extracted locally from a region surrounding the pixel under consideration. In case two interferometric (single pass) acquisitions are available, the extra information can be exploited by the proposed detector following two main strategies. 1) the detection is performed on each acquisition and the detection masks are combined in a logical AND; 2) the correlations between the two acquisitions (inner products of each polarimetric channel) can be included in the vector space where the perturbation analysis is performed. Both the methodologies are analyzed using TanDEM-X data acquired in synchronization of AIS data, which allowed validation of the detection masks.