SHIP DETECTION FROM POLARIMETRIC SAR IMAGES

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1. ABSTRACT

Synthetic Aperture Radar (SAR) is an active radar that can provide high resolution images in microwave band under all weather conditions. SAR images have been widely used for fishing vessels detection, ship traffic monitoring and immigration controls [1, 2].

For single channel SAR image, ships can be separated from the sea clutter with an appropriate choice of Radar Cross Section (RCS) threshold, as the RCS of ships is higher than the surrounding sea clutter. Numerous studies have been performed to develop algorithms to detect ships in single channel SAR images automatically [1-5]. These studies only use amplitude information to detect ships.

Polarimetric SAR (PolSAR) systems provide four channel capabilities to measure the four scattering factors of a target [6]. Earlier work for ship detection by using PolSAR data has addressed the design of the optimum detector under the assumption of known target and clutter scattering parameters. Since this assumption is unrealistic for many radar applications, different detection algorithms that used training data were subsequently developed [7-10]. However, both single-channel SAR and PolSAR images contain azimuth ambiguities which arise due to the discrete sampling of the Doppler signal which is weighted by the two-way azimuth antenna diagram. Doppler frequencies higher than the pulse repetition frequency are folded into the central part of the azimuth spectrum so that aliased signals are produced [11]. The ambiguous signals obviously will be displaced in azimuth, since they are generated during the illumination intervals preceding and succeeding the illumination time of the main signal. For maritime applications, azimuth ambiguities are often visible due to the low-clutter background. Therefore, azimuth ambiguities will be easily recognized as ship targets and cause lots of false alarms. They have been extensively analyzed in the frequency domain or in the time domain [12]. Many approaches have been proposed for reducing the azimuth ambiguities in single channel SAR image [13].

This paper analyzed scattering mechanisms of the azimuth ambiguities for PolSAR images and proposed a method for detecting ships from PolSAR images. The basic idea is that very bright single-bounce or double-bounce scatterers will give rise to ambiguities in azimuth that look like fairly bright double-bounce or single-bounce scatterers, respectively. By using eigenvector-eigenvalue decomposition, three eigenvalues can be used to differentiate ship targets, azimuth ambiguities and sea clutter. The experimental results show that the proposed method can effectively reduce false alarms caused by the azimuth ambiguities.

2. REFERENCES

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