СЕКЦИЯ 4. ЛАЗЕРНАЯ ТЕХНИКА И ТЕХНОЛОГИИ

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ENHANCEMENT OF OBJECT DETECTION IN SAR IMAGERY USING ADAPTIVE CFAR

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Object detection in Synthetic Aperture Radar (SAR) imagery, specifically targeting ships on the sea surface, involves a multistep process. The primary operations include pre-processing, land-sea masking, speckle filtering, pre-screening using Constant False Alarm Rate (CFAR) detection, and discrimination of false alarms. Adaptive thresholding further refines object detection, using multiple window types around each pixel under test and applying discrimination criteria based on shape, size, texture, intensity, and contextual information. The discrimination process involves clustering contiguous detected pixels and eliminating clusters based on predefined criteria. Different noise distribution models like Gaussian, Rayleigh, Weibull, Gamma, Log-Normal, and K-Distribution are considered, impacting the CFAR algorithm's performance in maintaining a constant false alarm rate across various clutter scenarios. The selection of an appropriate noise model involves statistical, spatial, and contextual analysis of SAR image data. CFAR algorithms like Cell Averaging, Order Statistic, Adaptive CFAR, and others are utilized, each with its unique threshold calculation methods and suitability for different clutter environments. The scenarios consider CFAR application with and without speckle filtering, demonstrating the significance of speckle reduction for accuracy in ship detection.

The implementation involves Sentinel-1A SAR image data from Alaska Satellite facility, undergoing pre-processing steps like orbit correction and radiometric calibration. Subset, Thermal noise correction, Sea-land masking, Speckle filtering on ROI. Results from the scenarios show improved accuracy in ship detection with speckle filtering, as the improvement in the ENL (Expected number of looks) using Gaussian noise distribution model. Discrimination uses size parameter which considers length and height of connected pixels. Although further refinement in discrimination processes is needed for better precision. Outlier suppression techniques, such as employing median values instead of mean for threshold calculations, use of dataset from different platforms are suggested for future enhancements. In conclusion, the study explores CFAR-based ship detection in SAR imagery, highlighting the impact of speckle reduction on accuracy.

a *b*

Fig. 1. Before Speckle filter 33 ship target detected with reference to 18 targets (*a*) and after Speckle filter 15 ship target detected with reference to 18 targets (*b*)

Reference

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