Abstract

Bayesian Information Extraction from SAR Images

Allowing the acquisition of high-resolution images of the Earth under all weather conditions and both day and night, synthetic aperture radar (SAR) systems represent a very powerful observation tool. However, an automatic interpretation of the information which is contained in the reflected intensity of the SAR data is extremely difficult. These difficulties are due to the speckle phenomenon that can be regarded as a strong multiplicative noise affecting all coherent imaging systems.

In this thesis, a Bayesian approach for information extraction from SAR images is presented. The emphasis of this work lies on speckle removal and estimation of the radar cross-section to obtain images easier to analyze with standard image interpretation tools. Strongly related to this task are methods for feature extraction and segmentation.

Filtering SAR images, especially images of high resolution, requires a good preservation of important features, such as texture, edges and targets. In the discussed approach information about these features is extracted and used for the restoration of the radar cross-section. Not only relying on one single assumption as most techniques do, our algorithm uses multiple models to describe the image content.

To model textural properties, Gauss-Markov random fields are used. Their parameters, which characterize the texture of the image, are iteratively estimated taking into account the speckle noise. A region-growing segmentation algorithm is employed to detect edges and adapt the neighborhood of the Gauss-Markov model to preserve non-stationarities. As a last feature, targets are extracted by a statistical data analysis.

By suitably combining the extracted information, an improved maximum a posteriori estimate of the cross-section is obtained, which is due to the increased modeling in comparison with other approaches.