Classification of Segments in PolSAR Imagery by Minimum Stochastic Distances Between Wishart Distributions

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A new classifier for Polarimetric SAR (PolSAR) images is proposed and assessed in this paper. Its input consists of segments, and each one is assigned the class which minimizes a stochastic distance. Assuming the complex Wishart model, several stochastic distances are obtained from the h-phi family of divergences, and they are employed to derive hypothesis test statistics that are also used in the classification process. This article also presents, as a novelty, analytic expressions for the test statistics based on the following stochastic distances between complex Wishart models: Kullback-Leibler, Bhattacharyya, Hellinger, R\'enyi, and Chi-Square; also, the test statistic based on the Bhattacharyya distance between multivariate Gaussian distributions is presented. The classifier performance is evaluated using simulated and real PolSAR data. The simulated data are based on the complex Wishart model, aiming at the analysis of the proposal well controlled data. The real data refer to the complex L-band image, acquired during the 1994 SIR-C mission. The results of the proposed classifier are compared with those obtained by a Wishart per-pixel/contextual classifier, and we show the better performance of the region-based classification. The influence of the statistical modeling is assessed by comparing the results using the Bhattacharyya distance between multivariate Gaussian distributions for amplitude data. The results with simulated data indicate that the proposed classification method has a very good performance when the data follow the Wishart model. The proposed classifier also performs better than the per-pixel/contextual classifier and the Bhattacharyya Gaussian distance using SIR-C PolSAR data.

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