CLASSIFICATION OF POLARIMETRIC SAR IMAGES USING THE DEGREE OF POLARIZATION AND THE CO-POLARIZED PHASE DIFFERENCE

Yisok Oh and Geba Chang
Department of Electronic Information and Communication Engineering, Hongik University, Seoul, Korea, yisokoh@hongik.ac.kr

Abstract

There are various supervised and unsupervised classification algorithms for polarimetric SAR Images. Common unsupervised techniques for polarimetric SAR images are the entropy/alpha-based classification technique [1] and the three-component decomposition technique [2]. The entropy/alpha-based technique is to classify the polarimetric response of each pixel into an entropy-alpha diagram, in which the entropy and alpha are computed from eigen values and eigen vectors of the covariance matrices. The three-component decomposition technique provides the contributions of single bounce scattering, double bounce scattering and volume scattering, based on theoretical scattering models.

In this paper, we propose one unsupervised classification technique using the degree of polarization (DoP) and the co-polarized phase-difference (CPD) statistics [3], instead of the entropy and alpha. It is shown that the DoP is closely related to the entropy, and the CPD to the alpha. The DoP is defined as the relation of the Stokes vector elements. It is shown in this paper that the DoP can be computed from the measured Mueller matrix elements. The DoP explains the feature how much the effect of multiple reflections is contained. Hence, the DoP could be used as an important factor for classifying classes. For example, the bare surface or building have high values of the DoP because there are almost single reflection or double reflections, while the forest or pasture have low values of the DoP because it contains various multiple reflections effect.

It was also shown in this paper that the CPD can also be computed from the measured Mueller matrix elements. For the smooth surface scattering, the CPD is about 0°, and for dihedral-type scattering, the CPD is about 180°. The other regions, such as forest or crop areas, have various CPD values. We examine the DoP and CPD with JPL/AirSAR image data set of Kadukdo area in Korea. For classifying SAR data into mainly four classes such as bare surface, short-vegetation area, tall-vegetation area and village area, we select a threshold value for mean DoP, which provides classification between bare surface/village and short/tall-vegetation areas. We also select a threshold value for mean absolute CPD, which provides classification between village area/tall-vegetation and surface/short-vegetation areas.

The DoP-CPD classification algorithm is verified with the full polarimetric L-band AirSAR data of Nonsan area. The accuracy of this classification algorithm is shown, and the possible sources of errors are discussed in this paper. This classification technique may be applied to other polarimetric SAR data as well.
References

