Polarimetric Calibration of Spaceborne SAR Data under Faraday Rotation by Means of Sub-bands Analyses

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Abstract

There is an inherent ambiguity between FR distortion and the rotation component of the system distortion (x-talk). The time-variant characteristic of FR limits the multiple data acquisitions for the relaxed calibration condition. Instead, the characteristics of FR under the dispersion and the directional dependency enable the separation of FR from x-talk.

The ionosphere is a dispersive media. Each frequency component of SAR system experiences different level of FR. It monotonically increase or decrease depending on sign, and the change of FR across the bandwidth is proportional to the mean FR. The x-talk is also dispersive. It induces quasi-FR on real data, and its dependency on the frequency need be no longer monotonic, but constant across different acquisitions. This is the key of calibrating the polarimetric radar system under FR.

Such a sub-band analysis is also possible in the azimuth direction sub-bands. FR is dependent on the parallel component of the geomagnetic field along the propagation vector, which varies in the azimuth beam width. In the narrow beam width of space-borne SAR antenna, and limited azimuth bandwidth presenting on SAR system, the FR change across the azimuth spectra is linear, and proportional to the mean FR level. The quasi-FR from x-talk is expected to be antenna specific. This study verifies it from the analysis of many ALOS/PALSAR and ALOS-2/PALSAR-2 datasets.

The proposed algorithm relaxes significantly the constrains imposed by conventional polarimetric calibration approaches in the sense that: 1) there are no calibration devices (i.e. reflectors, transponders, etc.) required at the geomagnetic equator but they can still be located in areas where B·k=0; and 2) it allows the estimation of x-Talk levels from each single scene and not only where B·k=0 is fulfilled.

Keywords - Calibration methodology and techniques