Analysis and Mitigation of Polarimetric Distortions in C band and L band Spaceborne and Airborne PolSAR Data Using Calibration Algorithms

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Abstract:

PolSAR systems are prone to polarimetric distortions, such as channel imbalance, phase bias, crosstalk, and Faraday rotation, especially in spaceborne systems. This study aimed to calibrate Quad-pol and Compact-pol PolSAR datasets from RADARSAT-2, ALOS-2 PALSAR-2, RISAT-1, and UAVSAR to mitigate these distortions. Crosstalk was identified as the dominant distortion, significantly affecting data interpretation. The study applied the Quegan, Improved Quegan, and Ainsworth algorithms for crosstalk correction, finding Improved Quegan best for high-crosstalk datasets and Ainsworth for low-crosstalk datasets.

Methodology for PolCal:

The methodology adopted for airborne and spaceborne Quad-pol datasets is shown in the following figure

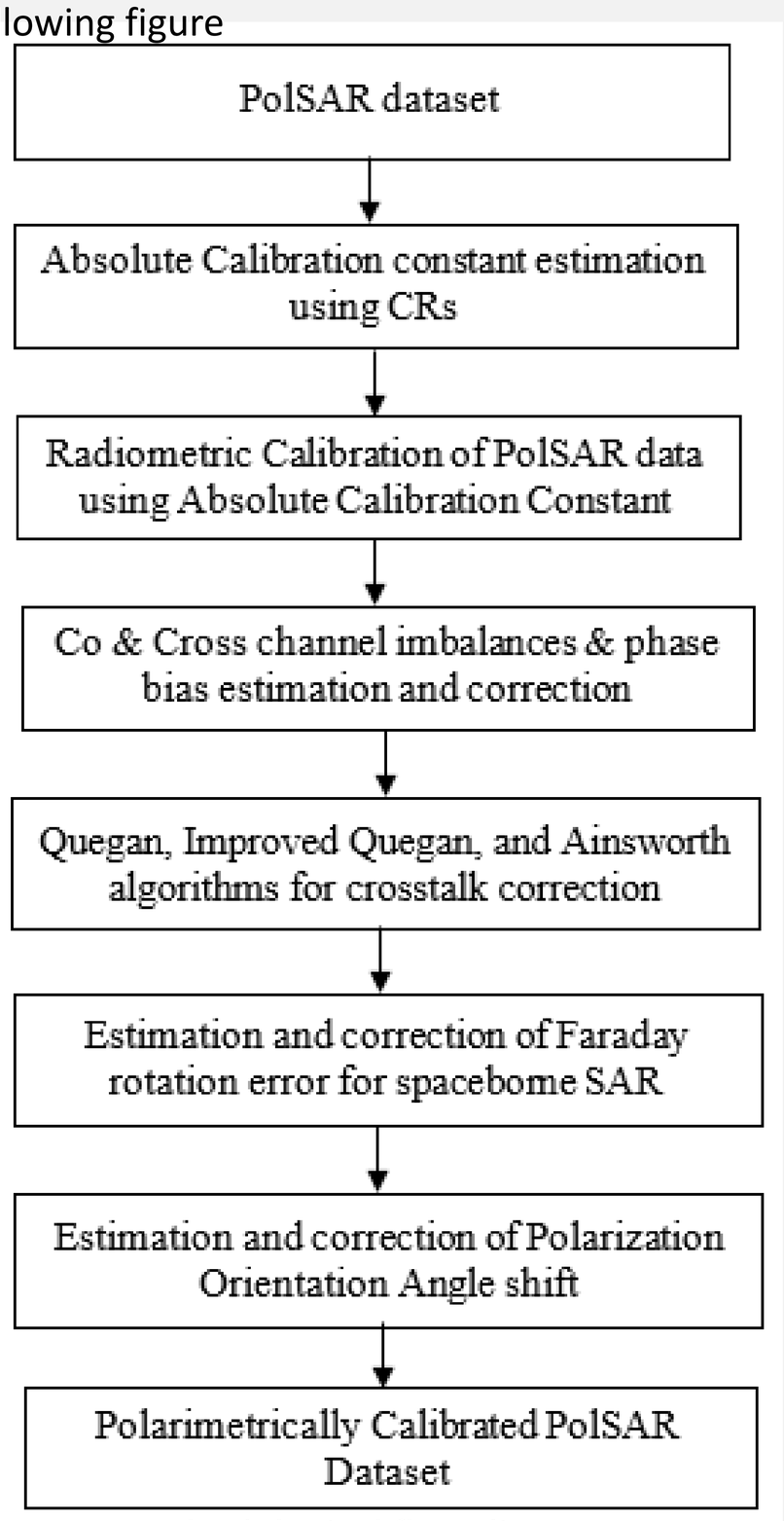

Figure 1. Methodological flow diagram

Deployment of CR:

Total four corner reflectors with one-meter inner side arm length are deployed at SOI and FRI campuses for RADARSAT-2 data

Figure 2. Field Campaign team after deploying the corner reflectors; (a) SOI ground; (b) FRI campus

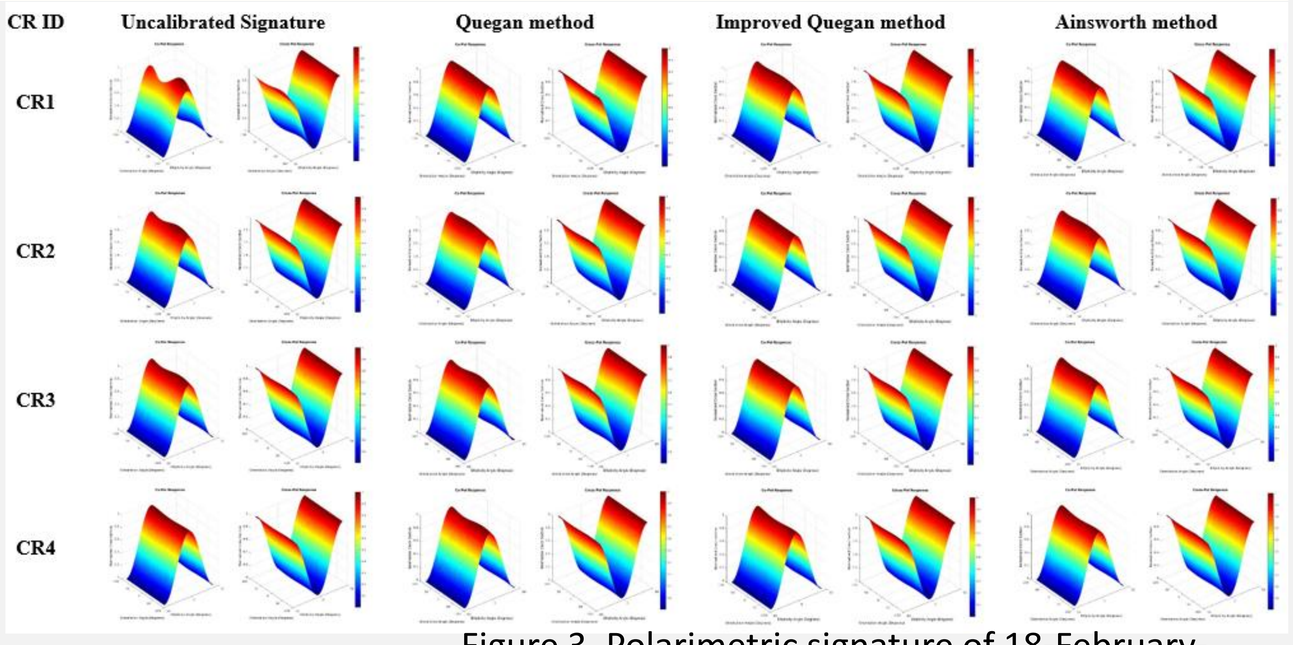

Figure 3. Polarimetric signature of 18-February-2019 RADARSAT-2 dataset

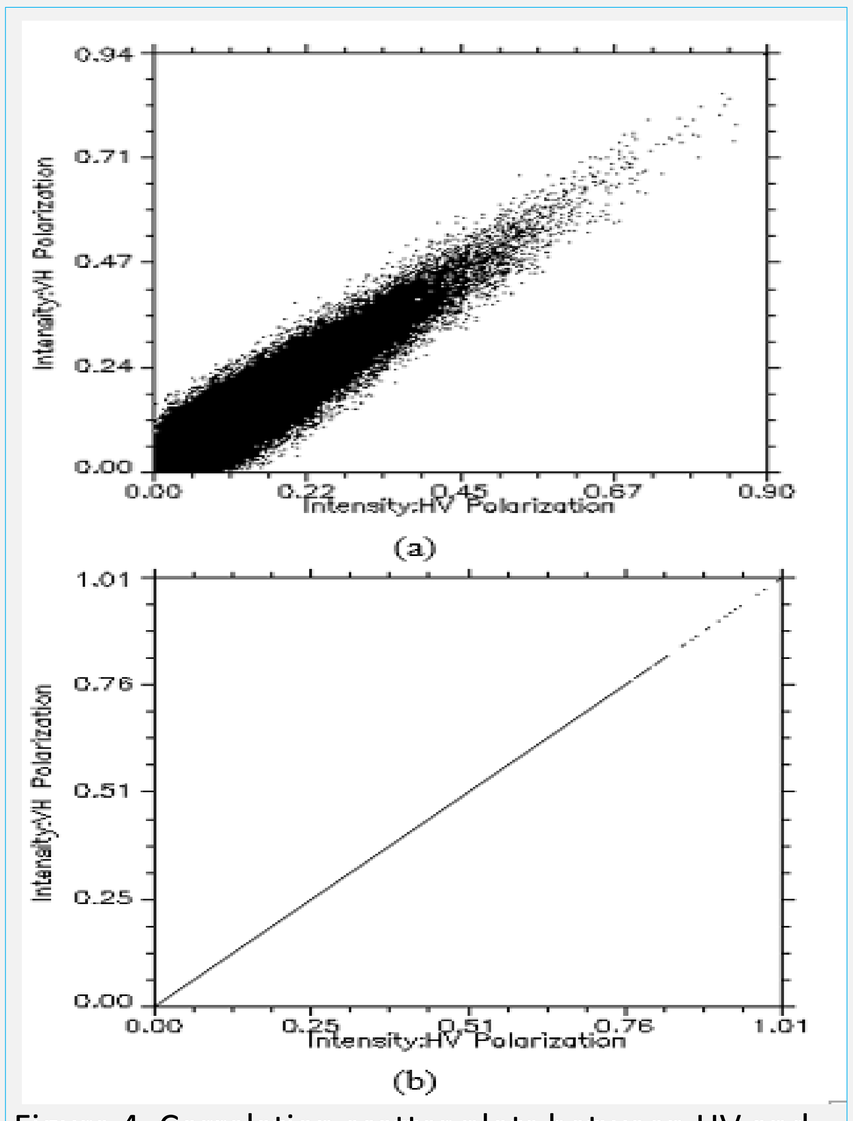

Figure 4. Correlation scatter plots between HV and VH elements of L-band ALOS-2 PALSAR-2 dataset (a) before PolCal ; (b) after PolCal

Conclusions:

The Improved Quegan algorithm was most effective for high-crosstalk datasets, while Ainsworth performed better for lower levels. Atmospheric Faraday rotation had negligible impact on RADARSAT-2 data. After calibration, polarimetric signatures of corner reflectors and ground targets aligned with theoretical models, and scattering reciprocity was restored. RISAT-1 C-band calibration using the Freeman algorithm reduced crosstalk and channel imbalance.

References:

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