SAR cross-calibration using natural targets

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Abstract

Calibration is an important process with important impact on SAR (synthetic aperture radar) applications. However, it is usually time-consuming and expensive to accurately calibrate an onboard SAR system. In some emergency cases, we do not need the exactly accurate calibration result, but a rough calibration result. Cross-calibration may be a good way to solve this problem by using a calibrated image as a reference. However, it can be a problem that the received power is different when the radiation power comes from different incidence angle and azimuth angle. In order to eliminate above-mentioned impact when using a calibrated image as a reference during calibration process, the Dubois model can be applied to transform the image correlation power to the same incidence. Image registration is also needed before calibration. Using the SLC (single look complex) images of GaoFen-3 and Sentinel-1, we did some simulations and evaluated the cross-calibration results through comparing with traditional calibration results.

Cross-calibration techniques have been used in optical calibration field for long time. In the field of radar technique, it also has been proposed in some literatures. However, due to the randomness of the scene and the special imaging geometry, the correlation power can be very inconsistent from different angles. In order to get the different correlation power from different angles, we selected the bare soil images as the references and retrieved the roughness and permittivity from the GaofenF-3 calibrated images. By using Dubois model, the correlation power in different incidences was simulated. After image registration, we can get a RCS (Radar Cross Section) reference map. Oh, Shi model and other land surface parameters retrieval approach was also used to get the cross calibration result under different circumstance. The Sentinel-1 absolute radiometric calibration constant was calculated by using the Gaofen-3 simulated RCS reference map.

To avoid geometric effects like layover, foreshortening and others, the reference region selected in the cross calibration process was a homogenous region like rainforest, grassland or bare soil etc. The calibration constant derived from simulated images was compared with that from the Sentinel-1 official document. The result showed the feasibility of the cross-calibration technique. It also showed that different accuracy results will be derived when different resolution images were used.

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