Rapid Geocoding of Satellite Sar Image with refined RPC Model

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The Rational Polynomial Camera (RPC) model has been demonstrated as a reliable replacement of the rigorous Range-Doppler (RD) model for geometric processing of satellite SAR datasets in our previous study. The relative geolocation accuracy of RPC model is usually better than 0.01 pixels with reference to the RD model. However, its capability in absolute geolocation of SAR data has not been evaluated quantitatively. In this paper a study was carried out to investigate the problem of geolocation errors with RD model and derived RPC model, and then an approach based on SAR image simulation was developed to improve the absolute geolocation accuracy of RD and RPC models.

The major error sources for satellite SAR geolocation are comprised of three aspects, i.e. error of orbit data, azimuth timing error (ATE) and range propagation delay (RPD). For most contemporary satellite SAR systems with precise orbit data, only ATE and RPD are significant. Usually ATE and RPD can be taken as constant across one scene, therefore they can be corrected by adding proper offsets to initial azimuth timing and range gate. Then the key problem is the robust estimation of the azimuth and range offsets. To solve this problem, the SAR simulation technique is employed to generate a simulated SAR image from a reference DEM, and then image matching between the real and simulated SAR images is carried out to identify homologous points which will be statistically analyzed to determine the offsets. After ATE and RPD are corrected, a refined RPC model can be build from the error-corrected RD model and used for SAR image geocoding.

The effectiveness of above approach was demonstrated by a few experiments with different reference datasets. In the first one a comparison between the geocoded ascending and descending SAR data pair was conducted to show the discrepancy. In other two experiments, a geocoded SAR data was overlaid onto an orthorectified Landsat TM image and an orthophoto to detect the absolute geolocation error. All the experimental results show that geolocation accuracies are substantially improved by the refined RPC model. In the fourth experiment, the computation time costs of satellite SAR image geocoding with both refined RPC model and error-corrected RD models are evaluated. The result shows that the time cost can be reduced by at least 90% with the refined RPC model used, consequently we can call SAR geocoding with RPC model as a rapid procedure.