ISPRS Technical Commission I Symposium, Sustaining Land Imaging: UAVs to Satellites
17 – 20 November 2014, Denver, Colorado, USA, MTSTC1-50

INTEGRATED DATA PROCESSING METHEDOLOGY FOR THE AIRBORNE DIFFERENTIAL REPEAT-PASS INTERFEROMETRIC SAR

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Commission I, WG I/1

KEY WORDS: Airborne InSAR, residual error, time-varying baseline, ground deformation

ABSTRACT:
Short temporal baseline and multiple ground deformation information can be derived from the airborne differential Interforemetric synthetic aperture radar (D-InSAR). However, affected by the turbulence of the air, the aircraft would deviate from the designed flight path with high frequent vibration and changes both in the flight trajectory and attitude. Restricted by the accuracy of the position and orientation system (POS), these high frequent errors can not be accurately reported, which would pose great challenges in motion compensation and interferometric process. The objective of this paper is to investigate the estimation of the residual motion errors in the SAR images and time-varying baseline errors, furthermore, to explore the integration data processing for the airborne D-InSAR applications, and thus to accomplish the correct derivation of the ground deformation.

1. INTODUCTION

As a major source of remote sensing data and with its unique merits of penetrating clouds and rains and independence of sun illumination, synthetic aperture radar (SAR) has become increasingly important in Earth observation applications. Ground deformation detection is one of the important applications for the interferometric SAR (InSAR). Compared with spaceborne sensors, airborne InSAR features higher spatial resolution and greater investigational flexibility. Thus, allowing it to obtain wide temporal baseline (several minutes to years) and multiple directions ground deformation information. Nevertheless, affected by the turbulence of the air, the aircraft would deviate from the designed flight path with high frequent vibration and changes both in the flight trajectory and attitude. Restricted by the accuracy of the position and orientation system (POS), these high frequent errors can not be accurately reported, which would pose great challenges in motion compensation and interferometric process.

Uncompensated motion errors would cause artefacts in the images, among which the most important are geometric distortions and phase errors. Although, such errors are often very small and can be neglected in most applications, this is not the case for repeat-pass interferometric SAR (D-InSAR) applications. Unlike with the single-pass airborne InSAR systems, residual motion errors of each flight track are independent and do not cancel out during interferogram generation, which would pose great challenges to derive accurate phase information from the co-registered imagery. The key problem of the airborne D-InSAR applications are how to accurately estimate the residual motion errors and the time-varying baseline errors from the data source, and compensate them in the data processing.

The objective of this paper is to investigate the integrated data processing of the airborne D-InSAR to correctly estimate the residual motion errors and time-varying errors, and compensate them, thus to accomplish the correct derivation of the ground deformation from airborne SAR measurement.

2. METHODOLOGY

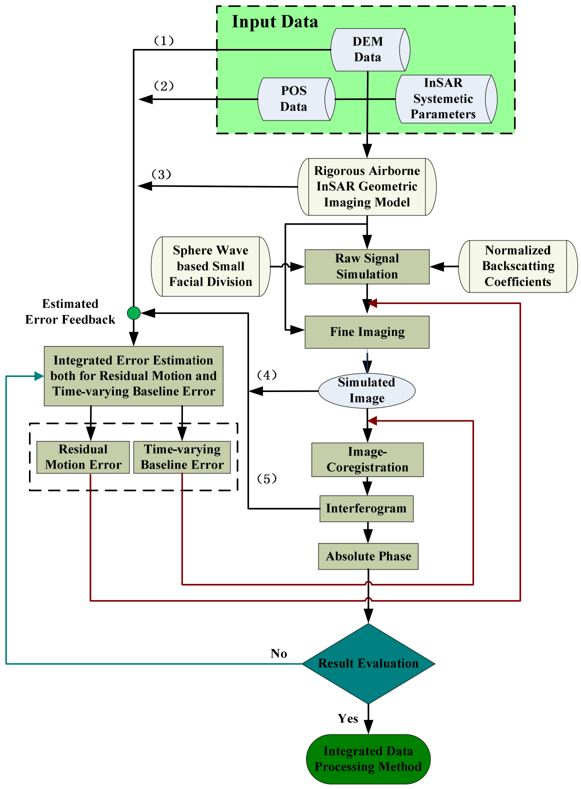

Fig. 1 Overall research scheme of integrated data processing for airborne D-InSAR

The integrated error estimation both for residual motion and time-varying baseline and their compensation are studied by using the simulated airborne InSAR data. The input data (DEM, POS and InSAR parameters) are from the real field test conducted by the newly developed airborne InSAR system. Using the simulated data, the integrated data processing theory for the airborne D-InSAR are established. This technology can ensure the accurate phase retrieval and ground deformation detection by airborne D-InSAR system.

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