

Spotlight SAR Processing Algorithm for LiteSAR Mission

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Abstract

LiteSAR is a new program aimed at validating key advances in synthetic aperture radar (SAR) technology, and related systems, that will reduce the cost and enhance the performance of this and future U.S. SAR missions. To boost commercial interest in LiteSAR program, the LiteSAR is designed to be capable of many imaging modes including a high resolution spotlight SAR mode.

The concept of Spotlight SAR has been previously related to computed tomography. Therefore, spotlight SAR processing algorithms such as backprojection and direct inverse Fourier methods have been demonstrated for the airborne imaging radars. The direct inverse Fourier method takes the advantage of efficient FFT process to achieve higher throughput rate. However, due to the need of motion compensation and the straight line model in formulating the tomography spectrum, images must be processed in small blocks first and then coherently added later. This dramatically reduces the overall processing throughput rate.

Unlike the airborne SAR, the motion effect is small enough such that over the spotlighting interval the range migration function can still be model as a polynomial with only second or third order. In addition, the spotlight SAR data can be viewed as the superposition of several strip mode data takes over an isolated bright target. Each data take is with a distinct squint angle and a maximum azimuth bandwidth of PRF. Using this concept, one can view the image processed from each data take as a subband image with a bandwidth limited by PRF. The full spectra of the full resolution image can therefore be formed by these subband spectra. The final spotlight image is the inverse Fourier transform of the full spectra. In addition to the throughput rate, there are two advantages of this algorithm. First, the well known range-Doppler algorithm or the chirp scaling algorithm may be used for reducing the software development cost. Second, since oversampling is not required for the subband image, it requires much less computer memory.

This spotlight SAR processing algorithm is validated by simulated point-target data as well as the SIR-C spotlight SAR data.

Preferred topic: Synthetic Aperture Techniques.