Deramp Range Migration Processing for Satellite-borne Spotlight Synthetic Aperture Radar

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Based on the two-step algorithm and range migration algorithm, the deramp range migration algorithm for the high-resolution satellite-borne spotlight synthetic aperture radar(SAR) is presented. The algorithm combines the advantages of SPECAN algorithm and range migration algorithm. The first step of the proposed algorithm implements a linear and space-invariant azimuth filtering that is carried out via a deramp-based technique representing a simplified version of SPECAN approach. This operation allows us to perform a bulk azimuth raw data compression and to achieve a pixel spacing no larger than the expected azimuth resolution of the fully focused image. Thus the azimuth spectral folding phenomenon, which is typical for satellite-borne spotlight SAR, is overcome. And the space-variant characteristics of the strip-map system transfer function are preserved. Secondly, the residual and precise focusing of the SAR data is achieved by applying the range migration algorithm. The range migration algorithm can be applied to carry out by simply accounting for a new system transfer function and by considering the new azimuth sampling frequency.

In this algorithm the squinted equivalent range model that is fitter for satellite-borne SAR is introduced. The equivalent velocity and equivalent squint angle are two important parameters in the algorithm and should accurately be acquired. When the equivalent velocity and equivalent squint angle acquired form the spacecraft ancillary data are imprecise, the estimation of the two parameters is circumvent through estimating the Doppler parameters of the target in the center of the scene. The equation between the two parameters and Doppler parameters is given. In order to avoid the azimuth spectral folding the full aperture is divided into subapertures during the estimation of the Doppler centroid. The energy balance is applied to estimate the Doppler centroid of every subaperture. Then the least square estimation is applied to estimate the Doppler centroid of the center target, which bases that the Doppler centroid of targets linearly varies with their position in azimuth. The Doppler frequency rate is achieved by the mapdrift. The step is so-called the estimation of the motion parameter. In some sense, the step can be recognized as the preprocessing of the deramp range migration algorithm.

Presented results confirm the validity of the proposed algorithm.