ANALYSIS AND FOCUSING FOR BISTATIC FORWARD-LOOKING SAR IN SPACEBORNE/STATIONARY CONFIGURATION

Robert Wang, Otmar Loffeld, and Holger Nies

Center for Sensorsystems (ZESS), University of Siegen, Siegen, Germany

ABSTRACT

The conventional monostatic SAR shows a limitation of achieving a high azimuth (angular) resolution if a forward-looking geometry is used [1]-[2]. One problem of the forward-looking configuration is that the differences in the Doppler frequencies of adjacent terrain points in the along-track direction are much smaller than the differences in the Doppler frequencies of adjacent terrain points in the across-track direction [2]-[4]. Another one is the left/right ambiguity which is introduced by the fact that the targets located at symmetrically about the flight path of the receiver have the same range history. Therefore, the monostatic SAR reaches its limits if a two-dimensional resolution is desired for the forward-looking case [5]. However, in some applications, a forward-looking imaging radar is highly desirable, e.g. military and aircraft landing systems. Fortunately, the bistatic configuration in principle offers the possibility of the forward-looking image [6]-[8].

In this paper, a Bistatic Forward-Looking SAR (BFLSAR) model will be considered, and the imaging geometry is shown in Fig. 1 (The platform with the forward-looking beam can be stationary.). In this model, the transmitter works in the conventional side-looking case, while the separated receiver operates in the forward-looking mode. In this configuration, the differences in the Doppler frequencies of adjacent terrain points in the along-track direction are enlarged by the contribution of the transmitter. Therefore, the high azimuth resolution can be achieved.

However, the forward-looking configuration of the receiver will also introduce two problems. One is the significant range-azimuth coupling. Another is still the left/right ambiguity of the slant range of receiver (i.e. range cell migration ambiguity).

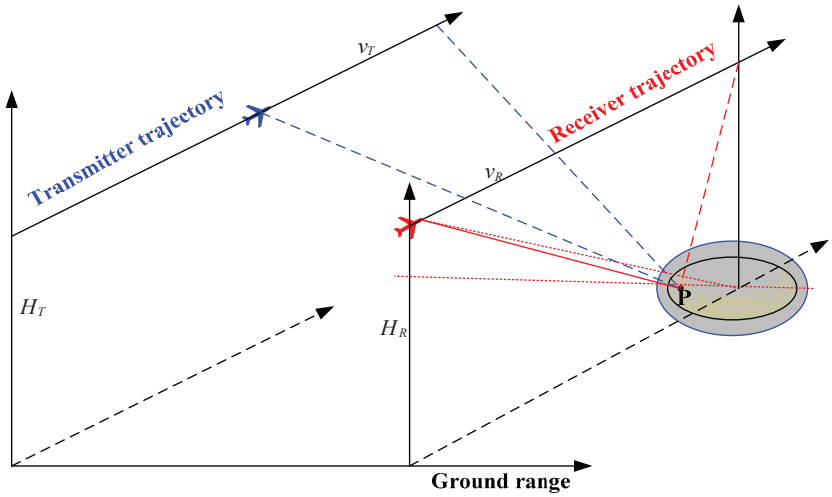

Fig. 1 Imaging geometry of the bistatic forward-looking SAR

In this paper, our main focus is to investigate the signal characteristic and develop the frequency-domain algorithms for the bistatic forward-looking SAR configurations. To analyze the signal characteristic and focus the BFLSAR data in the frequency-domain, the Bistatic Point Target Reference Spectra (BPTRS) is an important basis [9]-[10]. Unlike the monostatic case, where the point target reference spectrum is readily derived, applying the method of stationary phase, this approach is more complicated in the bistatic case. For the bistatic forward-looking configurations, we will firstly derive the accurate bistatic spectrum. Using the BPTRS, the frequency-domain algorithm can be applied to focus the BFLSAR data in the azimuth-invariant or -variant bistatic configuration. For the frequency-domain algorithm, the Extended Range-Doppler Algorithm might be a good choice due to the ability of handling the left/right ambiguity phenomenon.

For this final paper, we will validate the signal model, frequency-domain focusing algorithm, and analyze full-polarimetric image characteristics of targets by using real raw data. The real data will be acquired by ZESS's stationary receiving system whereas DLR's TerraSAR-X will be used as the transmitter. The collection with one with stationary receiver will be conducted by using a spaceborne/stationary forward-looking configuration.

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