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SPACEBORNE SAR GROUND MOVING TARGET DETECTION USING DUAL CHANNEL AND MULTI-CHANNEL SPACE-TIME ADAPTIVE PROCESSING

Abstract

A spaceborne SAR-GMTI (synthetic aperture radar - ground moving target indication) technique can be used for providing the position and velocity of ground moving targets. Recently, this technique has been known to have a possibility of the traffic monitoring of moving vehicle targets on the ground road by characterizing the dynamics of moving vehicles against a non-moving clutter background. The velocity component of moving targets, however, can often make the targets to be displaced and defocused in the SAR image. Furthermore, Doppler frequency of slow moving target falls into the clutter Doppler bandwidth so that it may be difficult to detect target. In this paper, the performance of DPCA (displaced phase center antenna) and STAP (space-time adaptive processing) are analyzed for the evaluation of GMTI technique. In case of DPCA, the displacement effect of the ground moving target position due to the variation of the velocity and acceleration is analyzed in range and azimuth directions. In order to reduce the performance degradation by target velocity, the velocity estimation of the moving target and its compensation scheme are presented in the dual-channel SAR system. The target velocity in range direction is estimated by the phase difference of dual-channel signals, and the azimuth velocity is computed from the correct FM rate by searching the matched filter bank with various FM rate. The range-walk quantity and the mapping error are compensated by location shift using the estimated range velocity, and the azimuth defocusing is resolved by modified FM rate. A STAP is a two-dimensional processing technique in both spatial and temporal filtering domain to optimally discriminate targets from clutter and jamming in the moving SAR platform. The characteristics of the ground moving target with clutter and interference in the moving platform can be analyzed in two dimensions of angle-Doppler domain. A ground moving target can be detected by MTI (moving target indication) filtering using STAP technique in the temporal domain, and target velocity can be estimated using matched filtering. Since interference signal is localized in angle of arrival and spread across the entire Doppler spectrum, interference source can be rejected by steering the antenna pattern to be null in the specific directions. For the inverse of ground clutter and interference covariance matrix, the projection matrix is applied to obtain the optimum filter weight vector. The performance of STAP algorithm will be analyzed along Doppler frequency in term of SCR (signal-to-clutter ratio) and SIR (signal-to-interference ratio), respectively. The performance result can be used for the improvement of the moving vehicle detection in the high resolution SAR image for the road traffic monitoring application.