3-D Position Estimation of Isolated Target In SS-BSAR

Cheng HU, Tao ZENG, Teng LONG

EE Department, Beijing Institute of Technology, P.R. China, 100081

Bistatic synthetic aperture radars (BSAR) have been in a focus of increasing research activity over the last decade. This reflects the progress in SAR technology, both hard and software, satellite positioning systems that allow synchronising BSAR subsystems, as well as achievements in aerospace technology. The engine behind this is a strong demand for the further improvement in the performance of microwave remote sensing systems, and it is expected that the practical utilisation of BSARs will respond to this demand. BSAR can be used to obtain essentially new information regarding land and ocean surfaces, operate as the remote change detectors to predict natural disasters, effectively use non-cooperative transmitters that reduce system costs, or similarly act as an auxiliary subsystem to existing monostatic SARs. The basic information regarding bistatic radar can be found in classic texts. If the transmitter and the receiver are stationary or followed parallel trajectories during the coherent integration time, they can be considered as a space (time)-invariant system. Meanwhile there are a number of new prospective researches in BSAR and many others where the transmitter and the receiver have their own non-parallel trajectories. From the system analysis point of view, this means that BSAR are no longer space (time)-invariant systems. Space-surface BSAR (SS-BSAR) is a subclass of Bistatic SAR (BSAR) that has an essentially asymmetric structure, e.g. the transmitter (Tr) may be on a moving space/air borne platform and the receiver (Re) is stationary on the ground or vice versa. Non-cooperative transmitters (NCT) such as non-Geostationary navigation and communication satellites can be used in SS-BSAR. BSAR systems have recently been the subject of several studies, but little attention has been given to the potential of the location of targets. In the paper, the performance of the estimation of 3-D position of a target (TPE) in a multi look SS-BSAR is obtained analytically and illustrated by computer simulation using ambiguity function analysis, and the maximum likelihood estimate (MLE) approach. It was shown that by using a multi look SS-BSAR all three coordinates of an isolated point target could be evaluated. Analytical closed form equations that characterize the measurement accuracy were derived. In the final these equations will be used to demonstrate various cases of more practical, including suboptimal trajectories choice.