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STUDY ON REQUIREMENTS OF SATELLITE ATTITUDE CONTROL ACCURACY IN GEO SAR IMAGING

Abstract

Characterized by short repeat time and large coverage area, Geosynchronous Earth Orbit Synthetic Aperture Radar (GEO SAR) has significant potential advantages over the conventional Low Earth Orbit SAR (LEO SAR). Due to the following facts, the way to determine the LEO SAR satellite attitude control accuracy can no longer be applied on GEO SAR. First, during the short synthetic aperture time, the LEO SAR trajectory is approximately linear and the attitude maneuver is simple. In contrast, the synthetic aperture time of GEO SAR is much longer and the curved trajectory makes the attitude maneuver perplex. On the other hand, the first and second order Doppler parameters are adequate for LEO SAR imaging. However, GEO SAR imaging need 1-4th order Doppler parameters. Current studies cover the effects of attitude error to the first and second order Doppler parameters, which is not sufficient for GEO SAR to prevent the imaging from defocus. Therefore, to study the requirement of attitude control accuracy is essential for GEO SAR Imaging.

This manuscript presents the necessity of accurate attitude control for GEO SAR imaging, and illuminates the maximum error threshold for different azimuth resolutions. Firstly, an exact and credible geometrical model, which takes orbital eccentricity, ellipsoidal ratio and rotation of the Earth into account, is established. Secondly, the expressions of 1-4th order Doppler parameters of GEO SAR are derived and their varieties from attitude error are illustrated. Thirdly, the influences of attitude controlling errors on a point target focusing result of GEO SAR, is simulated and analyzed. Finally, the accurate satellite attitude controlling in system design is needed for regular GEO SAR imaging is given, and the relation between threshold of attitude errors and resolutions is shown in this paper.