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STUDY ON LOW EARTH ORBIT SPACECRAFT HIGH RELIABILITY AND HIGH PRECISION POSITIONING TECHNOLOGY BASED ON GNSS

Abstract

High reliability and high precision positioning technology is an important indicator in satellite navigation and positioning field. The approach is especially a very difficult point to achieve high reliability and high precision positioning for the high dynamic spacecraft based on GNSS-Global Navigation Satellite System. Therefore, in this paper, high reliability navigation information assessment theory is firstly established, for the multi-mode GNSS constellation (GPS, BeiDou, Glonass and Galileo), in which the technique of calculating the integrity of GNSS system and user integrity are deeply studied. The simulation results show that the defined integrity assessment method can improve the reliability of the navigation system. When the navigation satellite system signal can not be used, the information can be transmitted to the users in the alarm time. Different integrity services can be provided according to different user requirements. Further research is finished that through the GNSS observation data analysis evaluate GNSS reliability, the data assessment algorithm and the simulation is completed for the navigation satellite pseudo-range and phase measurements. Compared with the single satellite navigation system (e.g. GPS), the integrated satellite navigation systems (e.g. Galileo+GPS) reliability performance is significantly improved. On the other hand, the precise positioning method is discussed using the improved pseudo-range and phase measurements. Basis of these technologies, the engineering algorithms for the spacecraft are established using reduced dynamic model and onboard GNSS non-difference observation data. The low orbit spacecraft initial orbit is determined by GNSS dual frequency P-code. The orbital parameters and various dynamic parameters are resolved only by the least squares iterative algorithm. In a recent flying space mission, the low orbit spacecraft high precision positioning experiment and post-processing analysis are carried out successful by GPS measurements. The orbit determination precision results show that the basic orbital variations comparatively smaller, R direction mean change is 0.033m , T direction mean change is 0.073m, N direction mean change is 0.044m, orbit changes in three-dimensional position basically is relatively stable, the average three-dimensional position error is 0.106m comparing with DORIS orbit, and R direction error is 0.040m compared with global SLR data. The final conclusion is that the engineering algorithms can meet the requirement of the high reliability and high precision positioning for the low-orbit spacecraft.