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IMPACT OF DYNAMIC MOTION ON THE PRECISION OF THE TWSTT IN SPACE EXPLORATION

Abstract

Two-way satellite time transfer (TWSTT) is currently one of the most precise and accurate time-transfer techniques available. The two stations exchange their time information to each other via the geo-stationary satellite to measure the simultaneous time interval at both sites in which the one pulse-per-second (1 pps) signal is generated by the local clock. Nowadays, the TWSTT is popular applied to time synchronization, and the accuracy of the technique is more than 1ns. The performance of time synchronization can achieve a few hundred picoseconds when the clock is stable and precise in both sides. In this paper, the impact of dynamic motion on the precision of the TWSTT based ranging is analyzed, and the formula of the ranging error calculation is deduced. The main three dynamic scenarios are discussed in this paper. The first scenario is that the two spacecraft are relative stationary. In this scenario, the basic ranging measurement formula is derived. The second scenario is that the two spacecrafts are moving close to each other. The third scenario is that the two spacecraft are moving apart from each other. In the last two scenarios, the distance of the two spacecraft is not steadiness because of the relative moving. Therefore, the basic ranging formula should be extended to fix the dynamic situation. The ranging error of the above scenarios is different. The higher the moving velocity is, the bigger the ranging error is. In a conclusion, the velocity is the key issue of the precision on the TWSTT based ranging is the dynamic motion scenario.