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THE ERROR MODEL OF TWO WAY SATELLITE TIME TRANSFER FOR A LOW-RATE DYNAMIC OBJECT

Abstract

An error model of two-way satellite time transfer (TWSTT) for a low-rate dynamic object is established in this paper. Calculous and vector algebra are used to analysis the precision of TWSTT for a low-rate dynamic object, and the error model, which is comprised of a series of equations, is hence deduced. Examples and simulation results, which are acquired according to actual experience data, are given when the low-rate dynamic object is a satellite-communication station on the vessel. Accordingly, influencing factors of precision are learnt from the model. Simultaneously, the way to reduce and eliminate the error is obtained. Some valuable conclusions are drawn as follows: (1) The main error of TWSTT for a satellite-communication station on the vessel comes from the horizontal movement and rise-fall of the vessel, which is related nearly to sailing circumstance, speed & direction of sailing, the geodetic azimuth angle, the geodetic elevation angle, etc. (2) When a vessel approaches a satellite, the error which is induced by horizontal movement gets declining. Meanwhile, the error owing to the rise-fall of a vessel becomes increasing. If the deck azimuth angle of the satellite-communication station on a vessel is equivalent to 90 degree, the change of transfer path brought about by horizontal motion is null. (3) For the change of a transfer path brought by rise-fall of a vessel, the precision of TWSTT is related to the initial phase of a sine wave. The error is pretty great through a single measure, the maximal error arrives at 7.28ns. An effective way to decline the error is to deal with the error data by mathematic method. (4) For a low speed object, movement makes a strong impact on precision, especially when we need win precision within 10ns for an object whose speed arrives at 10m/s. If we can measure real data of rise-fall samplings, we can correspond to the actual error graph employing the data and obtain a high timing precision in terms of the model.