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INTER-SATELLITE ORIENTATION OBSERVATION AND LONG-TERM AUTONOMOUS ORBIT DETERMINATION FOR CONSTELLATION

Abstract

Since the constellation rotation is unobservable in the constellation autonomous orbit determination system only with inter-satellite range measurement, the errors grow with time. An approach of inter-satellite orientation observation is discussed, furthermore, an algorithm is proposed for long-term high accuracy constellation autonomous orbit determination with discontinuous inter-satellite orientation information. For a typical MEO constellation, the natural illumination for inter-satellite orientation observation is analyzed, with the result that the equivalent magnitude of target satellite is confirmed to be 13 to 15 degree. Furthermore, a scheme for inter-satellite orientation observation is presented. One central target satellite, two observing satellites are designed in each orbit plane, judging observable windows by target satellite photometry. Using this strategy, at least one set of orientation observation can be carried out at any time within the whole constellation. In order to distinguish the exact image point of the target satellite, an identification strategy is proposed, basing on the high precision orientation of observer, high precision relative position between target satellite and observing satellite, star catalogue, and optical characteristic of the target satellite. Considering only discontinuous orientation information can be achieved, a self-adaptive filtering algorithm is proposed. Numerous simulation results demonstrate the effectiveness of the algorithm, which can modify the error caused by the constellation rotation, and then obtain the long-term high accuracy orbit information autonomously.