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APPROXIMATE MODEL FOR PULSAR NAVIGATION SIMULATION

Abstract

Pulsar navigation (PN) is a method for interplanetary position determination which has been a growing topic of interest in recent years. PN offers a position determination solution which, unlike other existing navigation methods, boast constant accuracy and precision regardless of a mission's duration or distance from Earth. Hence, the further from Earth a spacecraft were to travel, the better PN would perform in comparison to ground based tracking. We consider several pulsar navigation techniques including Earth-satellite time of arrival differencing or iterative position propagation. Each offers its own distinct advantages in different circumstances. The challenge of designing a suitable pulsar navigation system for a mission is made more difficult by the computer time required to run a simulation. In practice, pulsar signals curves comprise both noise and signal photons. SNR is typically very low so the incoming signals must be binned and then filtered to determine phase shifts. However stimulating a whole mission at this level of fidelity is impractical. This paper puts forward an algorithm and simplified model for pulse generation and detection to allow for faster and more extensive simulation of PN systems. The model will be validated by comparing it to higher fidelity models in a number of reference missions.