SHORT ARCS ORBIT DETERMINATION USING GPS

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This work is concerned with orbit determination using GPS signals. An especial case of truncated arcs assuming that GPS receiver data is available only when the satellite carrying the receiver flies over a ground tracking station is the main issue. To analyze the behavior of an extended Kalman filter (EKF) in real time satellite orbit determination using short arcs of data, the algorithm to determine the satellite orbit in real-time using the GPS system and Kalman filtering developed by Ref.[2] is used. It is a simplified and compact model with low computational cost. The EKF estimates the state vector, composed of the position and velocity components, plus bias parameters defining the GPS receiver clock offset. A simple fixed step size fourth order Runge-Kutta numerical integrator is found to be suitable to integrate the differential equations of orbital motion. The algorithm may use a large 10 or 30 seconds step-size of propagation time between GPS signal measurements. The force model in the equations of motion considers the perturbations due to the geopotential up to order and degree 10 of the spherical harmonics. The state error covariance matrix is computed through the transition matrix, which is calculated analytically in an optimized way, Ref.[1]. The raw single frequency pseudorange GPS measurements are used as observations by the Kalman filter. They are modeled taking into account most of the GPS satellite and receiver clock offsets. This algorithm has been formerly qualified using the Topex/Poseidon (T/P) satellite, and for this reason, is used as reference in this work. However, these real data are truncated as if they had been collected by the tracking and control station of INPE in Cuiabá, Brazil. That is, the data are obtained only when the satellite T/P is in the viewing area of the Cuiaba Brazilian station. The behavior of the Kalman filter is analyzed under such premises. The results of research are presented showing the degradation of performance when compared to the full arc orbit determination.

REFERENCES