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Author: Mr. Peng wang
China Aerospace Science and Industry Corporation, China, wp_fuyao@163.com

Prof.Dr. Yuguang Yang
China aerospace science & industry corporation, China, yyg001@sina.com

GROUND-BASED RADIO NAVIGATION SYSTEM FOR GEO SATELLITES

Abstract

Due to the distinctive feature of geostationary orbit, the lifespan of GEO satellites mainly depends on their capability of orbit keeping. Therefore, improving the navigation precision is very meaningful for the saving fuel of these satellites during their orbit keeping. Traditional TTC measures can provide navigation services of certain accuracy, but it can not meet the requirement of many GEO users. GPS can provide navigation services for many users, while it can not cover GEO orbit. A ground-based radio navigation system has the advantages the above systems. It is composed of several ground-vehicles that can transmit navigation signals to GEO orbit. Analysis shows that a 10-vehicle system can provide navigation services for all GEO satellites. Each vehicle has a transmitter, a rubidium atom clock and a bidirectional satellite timing subsystem. There is a chief-vehicle which is in charge of the whole system. All the atom clocks of other vehicle will have a time synchronization procedure with atom clock of the chief-vehicle periodically. This is achieved by the bidirectional satellite timing subsystem to keep timing accuracy between the clocks. Positions of the ground vehicles are designed to get the best PDOP(Position Dilution Of Precision), which is very critical to performance of the whole system. Numerical simulation shows that the ground-based radio navigation system can not only provide navigation services for GEO satellites, but also useful for semi-geosynchronous orbit spacecrafts, such as GPS, GLONASS and Beidou system. It can greatly reduce the consumption of fuels for orbit keeping, and thus prolong the lifespan of GEO or semi-geosynchronous satellites. It is suggest that L-band should be adopted for navigation signals for compatibility of other radio navigation systems. In the future, this system can also be expanded to provide navigation services for deep-space probes, cooperating with other navigation signals transmitted from the moon or spacecrafts near Lagrange Points.