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GEO DETERMINATION PRECISION ANALYSIS OF COMPASS INTEGRATED WITH GPS

Abstract

COMPASS is a satellite navigation system of China and planed to be finished in 2020. However, COMPASS can't supply sufficient navigation service for satellites in Geostationary Earth Orbit (GEO) because of poor satellites visibility and weak signal power for receivers in GEO. For example, the Number of Visible Satellite (NVS) is usually less than 4 so that the positioning calculation couldn't be finished by receivers.

With the development of the high sensitive receivers, it is possible to capture weak signal power in GEO. How to improve the satellite visibility is an important problem for COMPASS to work for GEO satellites.

To solve the problem, COMPASS integrated with Global Positioning System (GPS) is discussed here. COMPASS is supposed to work together with GPS so that visible satellites should be more and better geometric construction. The navigation precision for GEO satellites is expected to be better than single COMPASS does. However, NVS is still less than 4 sometimes. Then, the navigation algorithm based on Extend Kalman Filter(EKF) is proposed.

So, two algorithms and performance indexes for COMPASS integrated with GPS are proposed according to NVS.

1. Common point positioning algorithm with code pseudo-range information is used if NVS is more than 4. Based on Geometric Dilution of Positioning (GDOP) of the COMPASS integrated with GPS, the performance indexes, Maximum Optimal GDOP (MOGDOP) and Average Optimal GDOP (AOGDOP), are used to evaluate the positioning performance of integrated system here. MOGDOP is the maximum of all optimal GDOP which is the smallest in all GDOP corresponding to fixed place and fixed time. AOGDOP is the average of all optimal GDOP corresponding to fixed place and fixed time. MOGDOP and AOGDOP are used to estimate the worst positioning precision and the average positioning precision in the limited area during the available time, respectively.

2. A EKF is designed if NVS is less than 4. Position, velocity and clock bias are selected as states. The state equation is derived from the orbit dynamics model introducing disturbs from J2, sun-pressure, gravity of sun and moon. Measurements are pseudo-ranges from visible satellites. Measurement equation would be adjusted as NVS changing. The error estimated state relative to true orbital information is used to value the navigation performance.

Simulation shows that the COMPASS integrated with GPS could supply better positioning than COMPASS does only. The positioning performance in GEO could be maintained better.

Keyword: COMPASS, integrated satellite system, GPS, GEO