2012 International Conference on Indoor Positioning and Indoor Navigation, 13-15th November 2012

Stability Analysis of Tracking Weak GPS Signals through Non-coherent Ultra-tight GPS/INS Integration

Liang Chen[1,2],Yong Li[2],Chris Rizos[2],Zhi-zhong Liao[1]

[1]School of Astronautics
Northwestern Polytechnical University
Xi'an, China

[2]School of Surveying & Spatial Information Systems
The University of New South Wales
Sydney, Australia

ABSTRACT

In comparison to the coherent ultra-tight GPS/INS integration, the non-coherent ultra-tight integration is more preferable for tracking weak signals because the code discriminator used in the non-coherent integration is independent of the carrier phase, which makes it to be computed in regardless of C/N_0 being sufficient strong to track the carrier phase. This paper proposes a specific non-coherent ultra-tight integration approach to the weak signal tracking problems. Stability of this integration system is investigated under weak signal conditions using hardware-in-the-loop simulation. The experimental data including GPS IF signal and INS true data are collected in the same simulation scenario with different levels of C/N_0 by using Spirent GS 6560 GPS signal simulator and Nordnav R30 receiver. The true INS data are then processed by adding different error models according to the grades of INSs. The performance of the proposed method is analyzed by using variable levels of C/N_0 and INS measurements in comparison to a stand-alone GPS receiver. The analysis results lead to the following conclusions. First, in comparison to the classical scalar tracking loops used in the stand-alone receiver, the non-coherent ultra-tight integration system can enhance continuous navigation when the GPS signal is severely attenuated. Second, outliers in one loop may severely corrupt the EKF filtering results, which shows importance of quality control to the non-coherent ultra-tight GPS/INS integration system.

KEYWORDS: ultra-tight integration, GPS/INS, weak signal tracking, hardware-in-the-loop