Tightly Coupled Integration of Stand–alone GPS and MEMS–based Inertial Systems

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SUMMARY

At present, most integrated GPS/INS systems use differential GPS techniques. This is mainly due to the high accuracy of differential GPS in comparison with standalone mode. Unfortunately, this involves the deployment of a base station, which limits the range of navigation area and increases the cost and complexity of the system. With the development of precise point positioning (PPP), which is capable of providing decimeter to centimeter positioning accuracy without the need for a base receiver, it is possible to develop a high accuracy GPS/INS system based on one GPS receiver only. This research develops new algorithms for the integration of GPS PPP and MEMS-based IMU for precise positioning and attitude determination. Un-differenced ionosphere-free linear combination of carrier-smoothed code measurements is considered. Tropospheric delay, satellite clock, ocean loading, Earth tide, carrier-phase windup, relativity, and satellite and receiver antenna phase-center variations are accounted for using rigorous modeling. Tightly coupled mechanism is adopted, which is carried out in the raw measurements domain. Linear and nonlinear filters are developed to merge the GPS and inertial measurements. The performance of integrated system is analyzed using a real test scenario.