Integrating MEMS IMU with GNSS for Vehicle Navigation

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Key words: GNSS/GPS; Low cost technology; Positioning

SUMMARY

This paper highlights the integration of MEMS (micro-electro-mechanical systems) based IMU (inertial measurement unit) with GNSS (global navigation satellite systems) for use in low-satellite visibility areas. The successful integration of GNSS and IMU may lead to a low-cost INS (inertial navigation system) that accurately determines positions of vehicles without the constant need of satellite visibility. Since INS relies on internal measurements made by the IMU for positioning, it has an advantage of adding resistance to government spoofing or jamming. This makes it an indispensible tool for positioning and navigation that could be used from commercial to military ventures.

MEMS technologies have been studied for several decades for their potentials in autonomous navigation through INS. The technologies, which usually lead to low-cost and high-volume production of sensors, are currently being investigated for INS. The INS works by acquiring an initial horizontal position from GNSS with the IMU component allowing for continuous and reliable updates in position thereafter. In this study, the GNSS and IMU are integrated by implementing a loosely coupled Kalman Filter algorithm. This paper looks at combining a multi-system GNSS receiver (Emlid Reach M+) and low-cost high performance GNSS navigation sensor (3DM-GX5-45 GNSS/INS) for positioning solutions. The filter is to combine the GNSS solutions with IMU measurements and mitigate the errors associated with them to create more accurate positions. This filter repeatedly processes the measurements between the GNSS and IMU to estimate the error in the IMU. This paper includes the discussion on how the filter is designed and calibrated for the specific IMU in use.