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Simplified INS\GPS Integration Algorithm in Land Vehicle Navigation

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Abstract : Land vehicle navigation is subject of great interest today. Global Positioning System (GPS) is the main navigation system for positioning in such systems. GPS alone is incapable of providing continuous and reliable positioning, because of its inherent dependency on external electromagnetic signals. Inertial Navigation (INS) is the implementation of inertial sensors to determine the position and orientation of a vehicle. The availability of low-cost Micro-Electro-Mechanical-System (MEMS) inertial sensors is now making it feasible to develop INS using an inertial measurement unit (IMU). INS has unbounded error growth since the error accumulates at each step. Usually, GPS and INS are integrated with a loosely coupled scheme. With the development of low-cost, MEMS inertial sensors and GPS technology, integrated INS/GPS systems are beginning to meet the growing demands of lower cost, smaller size, and seamless navigation solutions for land vehicles. Although MEMS inertial sensors are very inexpensive compared to conventional sensors, their cost (especially MEMS gyros) is still not acceptable for many low-end civilian applications (for example, commercial car navigation or personal location systems). An efficient way to reduce the expense of these systems is to reduce the number of gyros and accelerometers, therefore, to use a partial IMU (ParIMU) configuration. For land vehicular use, the most important gyroscope is the vertical gyro that senses the heading of the vehicle and two horizontal accelerometers for determining the velocity of the vehicle. This paper presents a field experiment for a low-cost strap down (ParIMU)\GPS combination, with data post processing for the determination of 2-D components of position (trajectory), velocity and heading. In the present approach, we have neglected earth rotation and gravity variations, because of the poor gyroscope sensitivities of our low-cost IMU (Inertial Measurement Unit) and because of the relatively small area of the trajectory.

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