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Development of a robust real-time filtering algorithm for inertial sensor based navigation systems with zero velocity update

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Currently many GPS (Global Positioning System) satellites orbit the Earth providing users with information on position anywhere in the world and in all weather conditions. Information is gathered from the orbiting satellites and is merged with information from base towers on earth to locate a person's position. Although GPS is leading the navigation system industry it does suffer in that GPS signals are unable to pass through solid structures. This means GPS is unable to accurately work in dense urban areas or indoor environments. This research aims to develop a sensor based standalone indoor navigation system using a robust real-time filtering algorithm to accurately provide a person's positions and movement. Despite the numerous research and development on indoor navigation systems, little work has been done on maximizing the accuracy of the indoor navigation systems for achieving pin-point localization. The system proposed within utilizes a foot mounted IMU (inertial measurement unit) comprised of several inertial sensors capable of tracking a wearer's movements without satellite signals. IMU based systems, as with most other indoor navigation technologies, suffer from sensor "drift" during longtime navigation, can cripple the system. This research aims to filter sensory data collected by an IMU system through an EKF (extended Kalman filter) to correct drift. An EKF is an optimal estimation algorithm capable of estimating dynamic variables of indirect and uncertain measurements. In the team's endeavor to maximize the accuracy and efficiency of the algorithm they have found the integration of an EKF to be largely efficacious in mitigating drift error. We feel that inertial based navigation systems, when paired with a real-time filtering algorithm, offer an alternative to GPS navigation far more conducive to indoor environments.