Abstract

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Robust Modeling of Low-Cost MEMS Sensor Errors in Mobile Devices Using Fast Orthogonal Search

Accessibility to inertial navigation systems (INS) has been severely limited by cost in the past. The introduction of low-cost microelectromechanical system-based INS to be integrated with GPS in order to provide a reliable positioning solution has provided more wide spread use in mobile devices. The random errors of the MEMS inertial sensors may deteriorate the overall system accuracy in mobile devices. These errors are modeled stochastically and are included in the error model of the estimated techniques used such as Kalman filter Particle filter. First-order Gauss-Markov model is usually used to describe the stochastic nature of these errors. However, if the autocorrelation sequences of these random components are examined, it can be determined that first-order Gauss-Markov model is not adequate to describe such stochastic behavior. A robust modeling technique based on fast orthogonal search is introduced to remove MEMS-based inertial sensor errors inside mobile devices that are used for several location-based services. The proposed method is applied to MEMS-based gyroscopes and accelerometers. Results show that the proposed method models low-cost MEMS sensors errors with no need for denoising techniques and using smaller model order and less computation, outperforming traditional methods by two orders of magnitude.