Graduate School of Science and Technology Master's Thesis Abstract

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Thesis title	Toward Improved Inertial-based Odometry via Learning-based IMU Online Calibration		

Abstract

Modern navigation approaches, such as inertial odometry and visual-inertial odometry, are highly dependent on the inertial measurement unit (IMU). However, for low-cost IMU, the uncalibrated bias and noise will quickly propagate errors over time. This paper presents a deep data-driven inertial measurement unit (IMU) online calibration (DUET) method that can compensate for the run-time errors of the accelerometer and gyroscope to improve inertial-based odometry. We design a differential error learning strategy based on the kinematic motion model to train the sensor error compensation model. This strategy allows our method to learn IMU sensor errors, such as scale factors, axis-misalignment, and biases, solely from displacement and orientation increments given by external tracking systems. Then during the odometry computation, the trained model leverages the past inertial data to mitigate the sensor errors and thus reduces the integration errors to reflect the odometry state. The experiments were conducted on two public visual-inertial datasets. The results show that our method can reduce the errors of the accelerometer and gyroscope by 52% and 87%, respectively. These result in an average of 20% improvement in the orientation estimation accuracy compared with state-of-the-art learning-based methods, an average of 77% improvement in the velocity estimation accuracy compared with those from raw accelerations, and an average of 20% improvement in the position estimation accuracy of visual-inertial odometry, which is comparable to existing learning-based methods with lower operational complexity.