Robotics and Autonomous Systems Thesis Defense

Robust Extended Kalman Filter Based Sensor Fusion for Soft Robot State Estimation and Control

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Abstract

Soft robots provide an additional measure of safety and compliance over traditional rigid robots. Generally, control and modelling experiments take place using a motion capture system for measuring robot configuration. While accurate, motion capture systems are expensive and require re-calibration whenever the cameras are adjusted. While advances in soft sensors contribute to a potential solution to sensing outside of a lab environment, most of these sensing methods require the sensors to be embedded into the soft robot arm. In this work, a more practical sensing method is proposed using off-the-shelf sensors and a Robust Extended Kalman Filter based sensor fusion method. Inertial measurement unit sensors and wire draw sensors are used to accurately estimate the state of the robot. An explanation for the need for sensor fusion is included in this work. The sensor fusion state estimate is compared to a motion capture measurement along with the raw inertial measurement unit reading to verify the accuracy of the results. The potential for this sensing system is further validated through Linear Quadratic Gaussian control of the soft robot. The Robust Extended Kalman Filter based sensor fusion shows an error of less than one degree when compared to the motion capture system.

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