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B A C H E L O R T H E S I S
for
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IMU-assisted 3D object scanning with an RGB-D camera

Problem description:

Camera ego-motion estimation is a vital part for 3D object scanning. Existing 3D scanning methods often only rely on visual observation data to estimate camera motion. Although some of them achieved high accuracy, even small frame to frame errors can accumulate producing large drift and resulting in inconsistent modeling. Besides visual observation, additional sensor data can provide also valuable information for scanning, such as manipulator control input [3] and Inertial Measurement Unit (IMU) data [4]. Nowadays, IMU sensors are cheap and available in daily-used devices like smartphones. In order to achieve a higher-quality model estimation, probabilistic sensor fusion methods, such as Extended Kalman Filter (EKF), can be exploited. In this thesis, IMU sensor data will be combined with visual data through probabilistic sensor fusion methods to provide more consistent and robust 3D scanning result.

Tasks:

- Write a program to receive UDP packet of IMU data leveraging the Android app described in [2]
- Implement ICP-based [1][3] camera ego-motion estimation
- Combine IMU sensor data and visual data using Bayesian sensor fusion [4].
- Evaluate the contribution of IMU data to the scanning accuracy

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[4] Stephan Weiss, Markus W Achtelik, Simon Lynen, Margarita Chli, and Roland Siegwart. Real-time onboard visual-inertial state estimation and self-calibration of mavs in unknown environments. In *Robotics and Automation (ICRA), 2012 IEEE International Conference on*, pages 957–964. IEEE, 2012.