MSc assignment - Leica Geosystems

Inertial odometry algorithm development using a hybrid classical- and machine-learning based method

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Introduction

For general pose estimation applications, inertial odometry can be an attractive solution for scenarios where other sensors such as camera or GNSS fail. However, it is well known that the integration of the (biased) acceleration and angular rate measurements is prone to drift, resulting in a large error quickly.

To overcome the problem of integration drift, a novel approach is to complement classical state estimation techniques such as the Extended Kalman Filter (EKF) with machine-learning based methods [1][2]. A high-level overview of such methods is depicted in Figure 1. The objective of the thesis is to develop a novel algorithm that combines physics-based and data-driven models to improve the accuracy and reliability of the pose estimate.

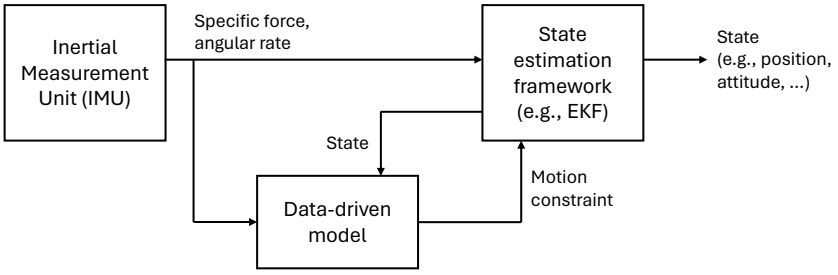

Figure 1: A high-level overview of how a data-driven model complements a state estimation algorithm [1][2]. The data-driven model is trained to detect motion patterns in the IMU data, and consecutively provides motion constraints to the state estimator to reduce IMU integration drift.

Thesis project

The thesis research project focuses on the intersection of sensor fusion and machine learning. The project should involve the following aspects:

- Investigate the state-of-the-art
- Develop a novel algorithm in Python
- Evaluate the algorithm in real-world scenarios and compare with existing solutions

You bring a solid mathematical foundation, strong analytical skills, and the ability to think abstractly. We are seeking a candidate with a genuine enthusiasm for exploring complex, theoretical topics, essential for pushing the boundaries of inertial odometry systems.

Leica Geosystems (leica-geosystems.com) is a leading global provider of geospatial solutions, located in Heerbrugg, Switzerland. At Leica Geosystems, you will benefit from our large network of experts to support your research and enhance your learning and professional growth.

The duration of the assignment is 10 months, for which working remotely is possible. A compensation of EUR 1950/month is offered. Please send your CV and motivation letter to Henri van Bavel and Manon Kok to apply.

References

[1] Liu, Caruso, et al. "TLIO: Tight Learned Inertial Odometry". In: *IEEE Robotics and Automation Letters.* 5.4 (2020): 5653-5660

[2] Bajwa, Angad, et al. "DIVE: Deep Inertial-Only Velocity Aided Estimation for Quadrotors". In: *IEEE Robotics and Automation Letters.* 9.4 (2024): 3728-3734