IPAB Summer Internship project proposal

Project topic: 3D map construction for safe autonomous vehicle navigation in Edinburgh

Supervisor: Prof. Subramanian Ramamoorthy

Project description:

A 3D map of the environment is crucial when developing an autonomous driving system. It provides a detailed, structured representation of the world, which could enhance the system's performance in tasks such as planning, obstacle avoidance, and navigating. It could also be used to create real-world road traffic simulations for research purposes.

The project will mainly focus on two things:

- Constructing a 3D map for the City of Edinburgh using ROS bags, which were previously recorded when the autonomous vehicle was driven around the city by a safety driver. The ROS bags contain outputs from sensors such as Cameras, Lidar, and GPS.
- Investigate the performance of different localisation algorithms when given the constructed map.

Approach/methodology:

- Implement algorithms such as Point-SLAM to construct a 3D mapping from Lidar point clouds and video recording of the environment.
- Evaluate the performance of localisation algorithms such as sensor-fusion and Multi-constraint EKF with metrics.
- Some difficulties I can identify at this stage are:
    - Filter obstacles from data (e.g. other cars driving next to you). Therefore, some form of filtering/threshold should be implemented for situations such as this.
    - Loop closure of the constructed model.

References/Previous work

- Point-SLAM produces accurate dense geometry and camera tracking on large-scale; however, the applications are mostly in indoor environments. (https://github.com/eriksandstroem/Point-SLAM)
- A Multi-State Constraint Kalman Filter for Vision-aided Inertial Navigation (https://intra.ece.ucr.edu/~mourikis/papers/MourikisRoumeliotis-ICRA07.pdf)
- Metrics for the Evaluation of localisation Robustness (https://arxiv.org/pdf/1904.08585)

My experiences:

I am a third year undergraduate student pursuing a degree in Artificial Intelligence and Computer Science.

I have 3 years of experience developing software and hardware solutions for Edinburgh University Formula Student(EUFS), where I found my interest towards robotics. I am the localisation and mapping software team lead in the society, leading a team of 8 members developing the SLAM (fastSLAM 2.0), pose estimate (Multi-constraint EKF, sensor fusion) algorithms used in an autonomous formula car.

As a software engineer I have developed solutions with languages such as C++, Python and TypeScript. I am also familiar with technology used in the industry such as ROS2, git, Docker and foxglove.

I want to join the IPAB internship programme to extend my experience and help out with the current research work. My CV is attached which details my experience in relevant fields.