Birla Institute of Technology and Science
Quark Summer Technical Project - 2021
Aerial Robotics: Path Planning and State Estimation

Organising Club: Aerodynamics Club, BITS Goa

Course Logistics
1. **Mentors:** Yash Jangir, Anish, Suhrudh. S
2. **Prerequisites:** Basics of Probability and Linear algebra
3. **Duration:** 5 + 1 weeks
4. **Course Repository:** All resources, evaluative materials shall be posted here.

Course Introduction
This course is a primer to anybody interested in Aerial Robotics. The course introduces Path planning in 3D and State Estimation for Aerial Robots, with the aim of setting students in the right direction for further education in the field of Aerial Robotics

The course starts off with the basics of Python programming, followed by introduction to path planning in two dimensions as a precursor to the same in 3D. Path Planning in 3D will be dealt with in greater detail. The course then moves on to State Estimation and Odometry for Aerial vehicles in 3 Dimensions.

Every week, Python notebooks shall be put up in the Course Repository. The notebooks are intended to ease the students' work of writing algorithms from scratch. Every notebook shall be considered for final Evaluation. Research paper discussion sessions shall be conducted, where state-of-the-art algorithms shall be discussed.

For the final project, any of the following shall be considered:
1. **Implementation of a Path Planning Algorithm** other than those discussed during the course.
2. **Implementation of a Kalman Filter** for sensor fusion.
3. **In-depth Analysis of a state-of-the-art algorithm**. A presentation is to be given by the student along with the analysis.

Evaluation

Component	Weightage
Python Notebooks	60 % (3 out of 5)
Final Project	40 %

Note: Students doing well in the course shall be inducted into the Aerodynamics Club.

Timeline

WEEK	TOPIC	TASK
Week 1	Basics of Python Programming	- Variables - Loops - Conditionals - Functions - Classes
Week 2	Search based Path Planning	Introduction to Graph search algorithms in 2D and their extension to 3D
Week 3	Sampling based Path Planning	Introduction to sampling based algorithms in 2D and their extension to 3D
Week 4	Introduction to Bayesian and Kalman Filters	Introduction to Bayesian filters, Markov Processes, Kalman Filter and Extended Kalman filter
Week 5	State Estimation Machinery	Definition of State in Aerial Robotics, State estimation in 2D and 3D
Week 6	Final Project	Final project submission as mentioned above

Notes:
1. Python Notebooks shall be posted on the Course repository. Students are expected to use them. Complete Instructions are given in the Repository.
2. Discussion and doubt-clearing sessions may be conducted as and when required by the students or the mentors.
3. Research paper discussion sessions shall be conducted after Week 3 and Week 5. In these sessions, a state-of-the-art algorithm shall be discussed.

Expectation from the Students:

1. Don't refrain from asking doubts, no matter how dumb you think they are. The instructors are here to help you. It is your duty also to ensure that your doubts are being cleared.
2. The skills you learn through the project will be far more valuable than any certificate you get here, so please don't cheat and be true to yourself in terms of learning outcomes.
3. Time is precious. In case you feel that your time is being wasted, please bring that to our notice and we will try our best to make sure that does not happen.

In case of any queries, feel free to contact the mentors of the course.

Mentor Contact Details:

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