IEEE ICMLA 2022

UAV Data-driven Control Challenge

https://www.icmla-conference.org/icmla22/

Overview

Advances in machine learning have boosted research interests in using data-driven methods to address some challenging problems in robotics and control communities. In line with this trend, we propose a challenge to implement data-driven methods to solve some UAV control problems in a simulated environment. This challenge consists of two tasks:

- Safe UAV control in a risky environment.
- Multi-UAV cooperative control in a risky environment.

For the first task, one needs to design a control policy for an autonomous UAV (in 3-D space but with unknown dynamics) to fly through an unstructured environment from a distribution of initial positions to a fixed target position (their coordinates are given as prior knowledge), with avoidance of some risky areas in the environment. The overall score of the task will be evaluated as a combination of (i) the closeness of the UAV's final position to the target location and (ii) the UAV's violation of risky areas throughout its motion.

For the second task, one needs to design control policies for multiple UAVs, with each UAV completing a similar task as the first task. An additional consideration in this task is the collision avoidance among all UAVs, i.e., the distance between any two UAVs must be greater than the sum of their safe radii. If this constraint is violated at any time instance, the overall score of the system drops to zero.

A Simulated Environment

To facilitate the data-driven control of UAVs for the above two tasks, a gym-like (ref. Open AI Gym) environment will be provided. The environment simulates the full dynamics of a quadrotor with a 13-dimension state space (3 positions+4 quaternions + 3 velocities + 3 angular velocities) and a 4-dimension input space (4 thrust forces generalized by 4 propellers). The input will be clipped before execution.

The following interface functionalities are offered by the environment:

- Set(state_val): set the state of a UAV to an arbitrary state_val.
- Get(): get the current state of a UAV.
- Step(input): simulate the dynamics of a UAV for one-step forward given input (Note the input will be clipped before simulation)
- Reset(): reset the state of a UAV to an initial value (or a sample from the initial distribution)
- RiskEval(): if the current state of a UAV is outside the risky areas, it will return 0, otherwise, it will return a positive value depending on how much the UAV enters the risky areas.
- Render(): visualize the environment/task.

IEEE ICMLA Challenge Organziers

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Questions and requests for access to the environment can be sent to any of the Challenge Organizers. (Please provide your name and affiliation.)

Submission and Evaluation

A short paper (4 pages – but 2 extra pages will be allowed on top of this if needed) describing the proposed algorithms and results on the provided environment should be submitted through the main conference submission website. These papers will be reviewed mainly based on:

- Originality and technical soundness of the developed methods.
- Performance (overall scores) in either or both described tasks. The evaluation will be conducted in the same environment where the participants train their algorithms.

Publication

Accepted papers will be published in the IEEE ICMLA 2022 conference proceedings.

Important Dates

Paper submission due	Sep 18, 2022
Notification of acceptance	Oct 7, 2022
Camera-ready papers & pre-registration	October 14, 2022
IEEE ICMLA 2022 conference	December 12-15, 2022

The authors should submit their papers through the main conference submission website. Papers must correspond to the requirements detailed in the instructions to authors. Accepted papers must be presented by one of the authors in order to be published in the conference proceeding.
All challenge submissions will be handled electronically. Detailed instructions for submitting a paper are provided on the conference home page at: https://www.icmla-conference.org/icmla22/