

Advanced control of a multi-rotor aircraft

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The purpose with the proposed projects is to control a multirotor aircraft such as a tricopter, quadcopter or hexacopter. The idea is to perform advanced control of a very interesting platform. The expected outcome is insight of both academic as well as industrial relevance, and of course, a very cool demonstrator and potential future research platform.



- **Real-time Model Predictive Control (MPC):** This task aims at using existing high-performance optimization algorithms to stabilize a tricopter. That is, to run a fast MPC control loop of critical importance. In the first part of the project, a simple model of the tricopter should be derived. This model should be validated using real flight data. Furthermore, an observer for this system should be developed. In the second part, the MPC algorithms are validated and run on a standard PC and simulation studies are performed in Matlab. In the third part of the project, the aim is to download the MPC algorithm to an embedded hardware and use this to control a real tricopter using on-line MPC.
- **Aerobatics:** This task aims at control of a tricopter (or possibly quadcopter) in extreme manouvers such as loops and flips. In the first part of the project, a non-linear model of the tricopter should be derived. This model should be validated using real flight data. Furthermore, an observer for this system should be developed. In the second part, optimal control

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should be applied using this model to compute advanced maneuver trajectories and strategies. A controller should be developed that makes the tricopter follow these precomputed trajectories. Finally, closed loop control should be tested in simulations. In the third part of the project, the aim is to download the controller to an embedded hardware and use this to control the tricopter.

- **Fault tolerant control of a hexacopter:** The idea here is to develop fault tolerant control strategies for a hexacopter. Since a hexacopter is overactuated, we would like to investigate the possibilities to diagnose critical errors like single or multiple rotor failures and once such a fault is diagnosed, reallocate the controls given the new setup.

A typical background for this project is a student who has taken advanced control courses as Control theory and Optimal control. Interest in applied automatic control is of course also necessary. To be able to do an implementation on a real platform, basic programming skills are required (advanced skills are of course an advantage).

If there are some ideas of changes to the projects, we are open for such discussions. Please send me an e-mail or pass by my office if you are interested, and we can discuss a tailored project for your interests and background!