Bachelor Theses/Master's Theses

Advanced and Distributed Control for Small Scale Quadrocopters

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Figure 1: Crazyflie 2.0 (https://www.bitcraze.io/)

Project Background

The small scale quadrocopter Crazyflie 2.0 is employed by the Institute of Electrical Engineering in Medicine to demonstrate and perform research on novel control and estimation algorithms and frameworks. The platform is modular, open and allows for fast prototyping. Recently, a ultra wide band-based localization system has been released on which novel localization techniques can be tested.

Projects available range from the implementation of state-of-the-art nonlinear control techniques to improve flight handling and autonomous navigation capabilities to serving as a testbed for message passing algorithms for distributed sensing and control, sensor fusion and parameter estimation.

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This project description thus acts as a container for numerous more concrete tasks that can be tailored to the abilities and interests of respective students. Examples include:

- Implementation of high-performance cascaded linear parameter-varying control schemes [4]
- Implementation of message passing-based distributed cooperative localization and sensing [1, 5, 6]
- Implementation of message passing-based control and estimation algorithms [2, 3]

References

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[3] Hoffmann, Christian; Rostalski, Philipp (2016): A Factor Graph Approach to Optimal and Predictive Control. Submitted to the 20th IFAC World Congress. Toulouse, France.

[4] Gonzalez Cisneros, Pablo Sebastian; Hoffmann, Christian; Bartels, Marcus; Werner, Herbert (2016): Linear Parameter-Varying Controller Design for a Nonlinear Quad-Rotor Helicopter Model for High Speed Trajectory Tracking. In : American Control Conference. Proc. Amer. Control Conf. AACC.

[5] Li, Bin; Wu, Nan; Wang, Hua; Tseng, Po-Hsuan; Kuang, Jingming (2015): Gaussian message passing-based cooperative localization on factor graph in wireless networks. In *Signal Processing* 111, pp. 1–12. DOI: 10.1016/j.sigpro.2014.12.001.

[6] Welling, Max; Lim, Joseph J. (2007): A Distributed Message Passing Algorithm for Sensor Localization. In David Hutchison, Takeo Kanade, Josef Kittler, Jon M. Kleinberg, Friedemann Mattern, John C. Mitchell et al. (Eds.): Artificial Neural Networks – ICANN 2007, vol. 4668. Berlin, Heidelberg: Springer Berlin Heidelberg (Lecture Notes in Computer Science), pp. 767–775.

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