TECHNISCHE UNIVERSITÄT MÜNCHEN
**LEHRSTUHL FÜR INFORMATIONSTECHNISCHE REGELUNG**
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M A S T E R ' S  T H E S I S
for
Student's name
Student ID 0815, Degree EI

# Human-Guidance for Multi-Robot Teams with Event-Triggered Communication

Problem description:

In multi-robot systems communication between individual robots is crucial to achieve a common goal, i.e. in cooperative manipulation. This communication is typically done in time-continuous fashion, which can lead to negative effects like delay or packet loss, especially in wireless networks with limited bandwidth. In order to reduce the amount of transmissions event-triggered communication has become a promising alternative [1]. In the case where the robot team is guided by a human operator behavior-based approaches are typically used to map the command from the human to the team and achieve coordinated motion [2]. However, such centralized approaches are becoming less of interest in modern multi-robot systems, due to high communication requirements and their vulnerability to single point failures. In contrast, in distributed systems no such central unit exist and in the case where the desired trajectory of the system is not known beforehand, it is typically only communicated to a subset of leaders. In order to achieve coordinated motion in such systems the agents need to agree on the desired trajectory [3] or estimate it in distributed fashion [4].
The goal of this thesis is to develop distributed estimation algorithms for human-guided multi-robot systems within the event-triggered framework.

Tasks:

- Literature research on event-triggered, distributed estimation and coordination.
- Proposition of a distributed trajectory generation algorithm for human-guidance of cooperative manipulations with even-triggered communication.
- Experimental design and evaluation of the proposed scheme.

Bibliography:

[1] D. V. Dimarogonas, E. Frazzoli, and K. H. Johansson. Distributed event-triggered control for multi-agent systems. *IEEE Transactions on Automatic Control*, 57(5):1291–1297, May 2012.
[2] S. Musić, G. Salvietti, P. Budde gen. Dohmann, F. Chinello, D. Prattichizzo, and S. Hirche. Robot team teleoperation for cooperative manipulation using wearable haptics. In *2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 2556–2563, Sep. 2017.
[3] D. Sieber and S. Hirche. Human-guided multirobot cooperative manipulation. *IEEE Transactions on Control Systems Technology*, pages 1–18, 2018.
[4] Yi Ren, Hanlei Wang, and Sandra Hirche. Fully distributed cooperation for networked uncertain mobile manipulators. *arXiv preprint arXiv:1809.07642*, 2018.

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