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MASTER'S THESIS

for

Student's name

Student ID 0815, Degree EI

Event-Triggered Pose Synchronization for Multi-Robot Teams

Problem description:

The consensus problem, where several agents need to agree on a common state, is an important tool for group coordination in distributed control of multi-agent systems [1]. Typically, only problems in a n -dimensional real vector space \mathbb{R}^n are considered, which is insufficient to model the full pose of robotic manipulators in task space. Since rigid body motions are described within the special Euclidean group, pose synchronization in $SE(3)$ is an important issue for many robotic applications. As inherited property of Euler-Lagrange systems, passivity is a useful tool to design robust and stable control laws for interconnected systems [2].

In addition, several issues regarding networked data arise when multiple agents communicate over a common channel. A lot of work in the literature considers time-continuous communication, sensing and actuation. This can lead to an inefficient use of limited energy resources and communication bandwidth, often resulting in deteriorated performance, especially in the case of wireless communication. Event-triggered control provides a promising alternative, by reducing the amount of sensing, communication and actuation to certain discrete time-instances [3].

The goal of this thesis is to investigate full pose synchronization with passivity guarantees for a team of Euler-Lagrange agents in the event-triggered control framework.

Tasks:

- Literature research on event-triggered control and consensus algorithms with focus on $SE(3)$.
- Proposition of a passivity-based, even-triggered pose synchronization algorithm for Lagrangian multi-agents systems.
- Evaluation in simulations and experimental validation on a real robotic platform.

Bibliography:

- [1] R. Olfati-Saber, J. A. Fax, and R. M. Murray. Consensus and cooperation in networked multi-agent systems. *Proceedings of the IEEE*, 95(1):215–233, Jan 2007.
- [2] T. Hatanaka, Y. Igarashi, M. Fujita, and M. W. Spong. Passivity-based pose synchronization in three dimensions. *IEEE Transactions on Automatic Control*, 57(2):360–375, Feb 2012.
- [3] 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.

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