Bachelor Thesis: Formation Control via Consensus-based Protocols in Discrete-Time Domain

Project Description

Motivation

Formation control of multi-vehicle systems has been studied extensively in the literature with the hope that through efficient coordination many inexpensive, simple vehicles, can achieve better performance than a single monolithic vehicle [1]. Consensus algorithms can be applied to the problem with good results. However, in the literature, many examples analyzes the problem in a continuous-time domain, rather than in a discrete-time domain. With the aim of developing a valid Python simulator which can visualize the problem and represent it in a 2D environment (and eventually also 3D), the following thesis is proposed.

The student will perform a bibliographic research to have a valid survey of the state of the art, which will then constitute a substantial part of the bachelor thesis. A simulation environment will be implemented in Python (discrete-time). The representation of the proposed algorithms in an equivalent discrete-time domain form will be addressed.

Additionally, the student will eventually study a tri-dimensional formation control via consensus-based control algorithms. This non-trivial task will be theoretically analyzed and, successively, simulated in the Python environment.

Goals

The following subtasks can be formulated:

- **Literature review**: Consensus-base Control. Formation Control and Consensus.

- **Implementation of the Simulation Environment**: A simulation environment for visualizing the idea will be developed in Python.

- **Discrete-Time Formation Control**: Portability of the continuous-time domain formation strategies into the discrete-time domain.
• **Analysis of the convergence conditions**: Under which hypothesis the problem gets to a formation.

• **Extension to the 3D case**: Theoretical analysis and simulation.

* Additional task

**Requirements**

In order to guarantee a smooth course throughout the work, the student should have a solid background in linear algebra. Knowledge of Python and object-oriented programming will be appreciated. Only applications of very motivated students will be taken into account.

**Contact**

Fabio Molinari  
Office EN 209, Einsteinufer 17,  
10587 Berlin, Germany  
Phone +49 (0) 30 314 - 25444  
Email molinari@tu-berlin.de

Date: February 28, 2018

**References**