distributed control and optimization in multi-agent systems

lecturers

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objective

The purpose of this course is to overview distributed consensus and optimization algorithms and their applications in multi-vehicle cooperative control. Theoretical results on distributed consensus algorithms for multi-agent systems are first introduced. This is followed by an overview of distributed optimization techniques and corresponding decomposition methods along with optimizationbased control design approaches such as distributed MPC. Application examples are then investigated where the distributed algorithms are used for coordinating vehicle formations (composed of wheeled and airborne mobile robots or deepspace spacecraft), and performing tasks such as rendezvous and formation keeping.

contents

1. Overview of recent research on distributed multi-vehicle cooperative control.
2. Consensus algorithms for singleand double-integrator dynamics. Specifically, we introduce basic consensus algorithms for singleintegrator dynamics, consensus tracking of a dynamic leader, consensus algorithms for doubleintegrator dynamics, consensus under realistic constraints, and swarm tracking algorithms.
3. Distributed optimization methods and various decomposition techniques (primal, dual, augmented Lagrangian / proximal point method), links to consensus algorithms, and their application in networked multi-vehicle distributed robotics problems.
4. Online optimization-based control approaches such as distributed model predictive control for multivehicle cooperation, distributed LQR and decomposition based methods that are applicable to collections of identical mobile agents. The presented topics are illustrated on cooperative rendezvous, distributed formation control, spacecraft formation flight, and other application examples in robotic networks.

prerequisites

Basic background in systems and control theory.

lecture notes

Will be distributed during the course.

homework assignments

Four homework sets will be distributed by the course website. Homework is graded on a scale from 1 to 10. Missing sets receive the grade 1. The final grade for the course is the average of the grades for the four homework sets.
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