Institut für Regelungs- und Steuerungssysteme
Prof. Dr.-Ing. Sören Hohmann
Wilhelm-Jordan-Weg, Geb. 11.20
76131 Karlsruhe | www.irs.kit.edu

Karlsruher Institut für Technologie

Contact:

Armin Gießler, M.Sc.

IRS, Raum 202
Tel.: 0721/608-43179
armin.giessler@kit.edu

Start: ab sofort **Duration:** 6 Monate

☐ experimental ☐ application-oriented ☒ theory-oriented

Your Interests:

☒ Optimal Control / Linear Quadratic Regulator
☒ Distributed Optimization

Master Thesis

Distributed Policy Optimization for continuous-time LQR

Motivation:

Many practical systems are composed of numerous smaller subsystems that are dynamically coupled through their state variables. Each subsystem is controlled locally via state feedback controllers. The design of individual controller parameters is typically time-consuming and, ideally, should be automated through the solution of a quadratic optimization problem. However, the distributed nature of these systems imposes structural constraints: certain entries in the overall state feedback matrix must be zero. Such sparsity constraints cannot generally be incorporated directly into the Algebraic Riccati Equation. A centralized approach already exists that employs a discrete-time projected gradient descent method [1, Sec. 7].

Problem Statement:

The goal of this work is to develop a continuous-time method for solving the LQR problem in a distributed fashion while satisfying the aforementioned sparsity pattern. The work will be devided into two phases.
In the first phase, a continous-time centralized method should be developed by combining the policy gradient flow introduced in [1] and the projected gradient flow of [2]. In the second phase, the approach should be be extended to a distributed setting using distributed optimization techniques [3]. It should be analyzed whether the optimization problem can be reformulated so that the zero entries are no longer treated as optimization variables or if constrained distributed optimization methods, such as those based on dual decomposition [3, Sec. 4.3], are needed.

[1] J. Bu, A. Mesbahi, and M. Mesbahi, Policy Gradient-based Algorithms for Continuous-time Linear Quadratic Control, 2020
[2] K. Tanabe, An algorithm for constrained maximization in nonlinear programming, 1974.
[3] Yang, Tao, et al., A survey of distributed optimization, 2019