Universität Stuttgart
Institut für Systemtheorie und Regelungstechnik
Prof. Dr. Frank Allgöwer

Open Thesis (MA)

Safety Controllers for Stochastic Interconnected Systems under Changing Topologies

Description:

Control of safety-critical systems usually requires rigorous proofs of correctness against safety specifications. This problem entails designing a controller that ensures that the system *avoids* some unsafe or dangerous behaviours. Usually, one solves this by utilizing control barrier certificates which are functions that effectively separate the safe and unsafe regions, so that the system does not visit the unsafe regions of the state set. However, when presented with complex control systems, especially large-scale ones with underlying stochastic dynamics, the safety problem is hard to solve in a scalable manner.
The goal of the thesis is to synthesize safety controllers for large-scale interconnected stochastic control systems in a modular fashion when interconnection topologies are randomly changing (like Markovian switching). This can be done by leveraging some compositionality conditions using dissipativity theory. In this context, the student is tasked with reviewing the relevant literature on control barrier certificates and its extension to interconnected stochastic control systems, and correspondingly identifying suitable methodologies to tackle changing interconnections. Then, the student shall develop the theory necessary for providing probabilistic safety guarantees, and demonstrate the results via some case studies.

Prerequisites:

- Basic knowledge in control theory
- Basic knowledge in stochastic systems (ideal)
- Programming skills, *Matlab or Python*

Supervisor:

Mahathi Anand
Room 2.238

Area:

Formal methods in control
Networked Control Systems

Properties:

Type: MA

30% literature
40% theory
30% implementation

Beginning:

Any time

Further information on www.ist.uni-stuttgart.de/lehre/bama

Aushang vom September 28, 2023