Informatik 11
Embedded Software

RWTH AACHEN UNIVERSITY

Bachelor Thesis

Computationally Efficient Graph-based Motion Planning of Networked Vehicles

Problem Statement

Trajectories for networked, autonomous vehicles can be planned with model predictive control. In the project GROKO-Plan, the model is given by a motion primitive automaton (MPA). The states of the MPA have a branching factor of five.

The dynamics of multiple vehicles are described by a synchronous side-by-side composition of multiple MPAs. Figure 1 illustrates an example for two MPAs. The number of states and available transitions in the MPA modeling the centralized multi-agent system grows exponentially with the number of vehicles. In the current centralized MATLAB implementation, this results in an MPA and a transition matrix which become too large to hold in RAM.

The optimal trajectory is currently determined with a variant of the A*-algorithm. The computational efficiency of this algorithm needs to be improved. This goal can be reached both by efficient implementation and by using an incremental search algorithm. Besides a computationally efficient optimal search algorithm, a suboptimal anytime algorithm such as RRT is needed to guarantee real-time performance of trajectory planning.

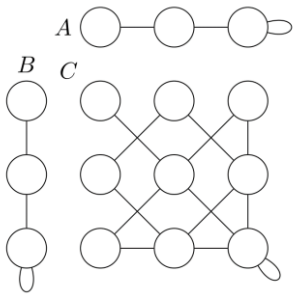

FIGURE 1 SYNCHRONOUS SIDE-BY-SIDE COMPOSITION C OF TWO MPAS A AND B.

Task

- Improve implementation efficiency in MATLAB for existing A* search algorithm to increase the number of vehicles in centralized planning with an MPA with a branching factor 5
- Implement an incremental search algorithm to improve computational efficiency for both centralized and distributed planning
- Develop and implement an anytime search algorithm for trajectory planning with a limited prediction horizon for real-time computation of 20 vehicles in the priority-based distributed approach
- Evaluate the developed algorithms in simulation or experiment in the CPM Lab

Qualifications

- Knowledge of MATLAB and/or C++
- Affinity to mathematics
- Student of Automation Engineering, Computer Science, Mechanical Engineering or a similar study program

Contact

Patrick Scheffe, M. Sc. RWTH
scheffe@embedded.rwth-aachen.de
Please include in your application: transcript of records, CV and certificates.