

Master / Bachelor Thesis

Distributed Trajectory Planning for Networked Vehicles Using Graphs

Problem Statement

The project GROKO-Plan aims at developing a graph-based planning method for optimal cooperative trajectories for interacting vehicles. In a broad sense, the goal of trajectory planning is to find a sequence of control inputs that take a vehicle from a starting position to an end position.

The optimal solution of the trajectory planning problem for a system consisting of multiple agents can be obtained when formulating the centralized control problem that considers all agents. In such a system, the complexity grows exponentially with the number of agents. A typical way to reduce the computational load is to distribute the control problem among the agents. Figure 1 illustrates the dependencies and communication links of agents in those two strategies of controlling a multi-agent system.

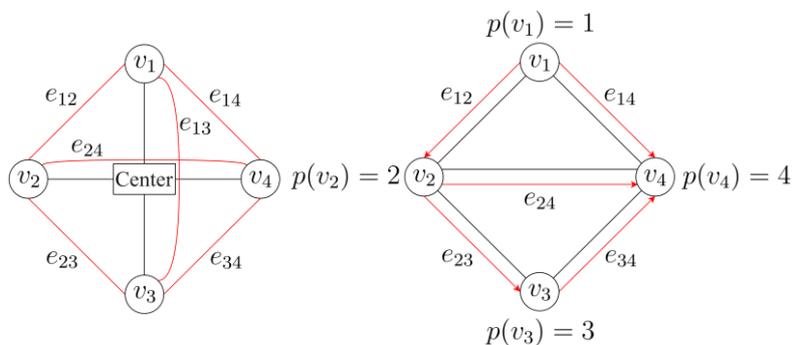


FIGURE 1 GRAPH REPRESENTATION OF NETWORKED AGENTS. BLACK EDGES CORRESPOND TO THE COMMUNICATION GRAPH AND RED EDGES TO THE COUPLING GRAPH. LEFT: CENTRALIZED SYSTEM. RIGHT: DISTRIBUTED SYSTEM.

There exist two major challenges in distributed trajectory planning. Firstly, planned trajectories need to be collision free, which is more difficult to guarantee than in the centralized problem formulation. Secondly, the graph search algorithm on board of the vehicles should be real-time compliant. This is challenging due to the complexity of the graph search algorithm, which grows exponentially with every road user that is taken into account.

Task

- ▶ Implementation of networked control of multiple vehicles using priority-based non-cooperative control
- ▶ Development of strategies for priority distribution with the goal of reducing computation time
- ▶ Comparison to planned trajectories using centralized control
- ▶ Evaluation in simulation / on real hardware

Qualifications

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

Advisor

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