Abstract:

This paper presents a framework for gener- ating time-optimal velocity profiles for a group of path- constrained vehicle robots that have fixed and known initial and goal locations and are required to maintain communication connectivity. Each robot must follow a fixed and known path, arrive at its goal as quickly as possible (or at least not increase the time for the last robot to arrive at its goal) and stay in communication with other robots in the arena throughout its journey. The main contribution of this paper is the formulation of the problem as a discrete time nonlinear programming problem (NLP) with constraints on robot kinematics, dynamics, collision avoidance, and communication connectivity. We develop Partition Elimination constraints that assist in ensuring that the communication network is fully connected (no network partitions). These constraints are enforced only when net- work partitions would otherwise occur, an approach which significantly reduces the problem size and the required computational effort.

In addition, we introduce path-constrained jammer robots with known paths and velocity profiles into the scenario. These jammer robots have an effective jamming range and disrupt all communications within this range. Except for the jammers, all robots must remain outside this jamming range at all times. We investigate the scalability of the proposed approach by testing scenarios involving up to fifty (50) robots. Solutions demonstrate (i) the trade off between the arrival time and the communication connectivity requirements in scenarios with and without jamming; and (ii) the dependence of computation time on the number of robots.

BibTex Reference:

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