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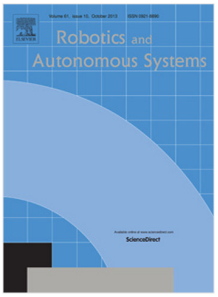

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Integrated Online Trajectory Planning and Optimization in Distinctive Topologies

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Abstract

This paper presents a novel integrated approach for efficient optimization based online trajectory planning of topologically distinctive mobile robot trajectories. Online trajectory optimization deforms an initial coarse path generated by a global planner by minimizing objectives such as path length, transition time or control effort. Kinodynamic motion properties of mobile robots and clearance from obstacles impose additional equality and inequality constraints on the trajectory optimization. Local planners account for efficiency by restricting the search space to locally optimal solutions only. However, the objective function is usually non-convex as the presence of obstacles generates multiple distinctive local optima.

The proposed method maintains and simultaneously optimizes a subset of admissible candidate trajectories of distinctive topologies and thus seeking the overall best candidate among the set of alternative local solutions. Time-optimal trajectories for differential-drive and carlike robots are obtained efficiently by adopting the Timed-Elastic-Band approach for the underlying trajectory optimization problem. The investigation of various example scenarios and a comparative analysis with conventional local planners confirm the advantages of integrated exploration, maintenance and optimization of topologically distinctive trajectories.

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