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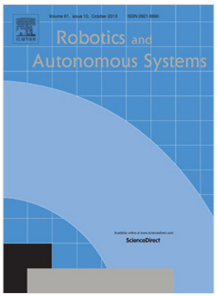

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Decentralized Safe Conflict Resolution for Multiple Robots in Dense Scenarios

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Abstract

Multi-robot conflict resolution is a challenging problem, especially in dense environments where many robots must operate safely in a confined space. Centralized solutions do not scale well with the number of robots in dynamic scenarios: a centralized communication can cause bottlenecks and may not be robust enough when channels are unreliable; the complexity of algorithms grows with the number of robots, making online re-computation too expensive in many situations. In this work, we propose a decentralized approach for conflict resolution where robots show reactive and safe behaviors, avoiding collisions with both static and dynamic objects, even under unreliable communication conditions and with low resources. They detect conflicts with neighboring obstacles locally and then apply rules to surround them in a roundabout fashion, assuming that others will follow the same policy. The method is designed for unicycle robots with range-finder sensors, and it is able to cope with noisy sensors and second-order dynamic constraints, ensuring always collision-free navigation. Besides, a set of metrics and scenarios for benchmarking in multi-robot collision avoidance are proposed. We also compare our method with others from the state of the art through extensive simulations. Experiments with real robots are also presented in order to show the feasibility of the system.

Keywords: Dense conflict resolution, decentralized multi-robot systems, safety-enhanced and reactive behaviors, benchmarking, collision avoidance

1. Introduction

Multi-robot systems are becoming more common in the last decades thanks to recent advances in communication, control and perception technologies. The use of cooperative teams of multiple robots, both aerial and ground, is of interest in many applications such as surveillance, traffic management, industrial robots,

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