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Robust MADER: Decentralized multiagent trajectory planner robust to communication delay in dynamic environments

J. Rached; J. Tordesillas Torres; J.P. How; K. Kondo; P.C. Lusk; R. Figueroa

Abstract-

Communication delays can be catastrophic for multiagent systems. However, most existing state-of-the-art multiagent trajectory planners assume perfect communication and therefore lack a strategy to rectify this issue in real-world environments. To address this challenge, we propose Robust MADER (RMADER), a decentralized, asynchronous multiagent trajectory planner robust to communication delay. RMADER ensures safety by introducing (1) a Delay Check step, (2) a two-step trajectory publication scheme, and (3) a novel trajectory-storing-and-checking approach. Our primary contributions include: proving recursive feasibility for collision-free trajectory generation in asynchronous decentralized trajectory-sharing, simulation benchmark studies, and hardware experiments with different network topologies and dynamic obstacles. We show that RMADER outperforms existing approaches by achieving a 100% success rate of collision-free trajectory generation, whereas the next best asynchronous decentralized method only achieves 83% success.

Index Terms- Asynchronous communication, autonomous aerial vehicles, decentralized control, multi-agent systems, open source software, robustness, swarm robotics.

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