db-ECBS: Interaction-Aware Multirobot Kinodynamic Motion Planning (Abstract Reprint)

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Abstract

Kinodynamic motion planning for a multirobot system with different dynamics and actuation limits is a challenging problem. The difficulty increases with the presence of aerodynamic interaction forces that occur when aerial robots fly in close proximity. Due to these complexities, existing planners either rely on simplified assumptions (like ignoring robot dynamics and interaction forces) or produce highly suboptimal solutions. This article presents a kinodynamic motion planner for a heterogeneous team of robots that respects robot dynamics, scales well to 16 robots, and directly reasons about interaction forces between aerial robots operating in close proximity. Our method, db-ECBS, generalizes the multiagent path-finding method Enhanced Conflict-Based Search (ECBS) to the continuous domain by using the single-robot kinodynamic motion planner discontinuity-bounded A. The planner db-ECBS operates on three levels. Initially, individual robot trajectories are computed using a graph search that allows bounded discontinuities between precomputed motion primitives. The second level identifies interrobot collisions or interaction force violations and resolves them by imposing constraints on the first level. The third and final level uses the resulting solution with discontinuities as an initial guess for a joint-space trajectory optimization. The procedure is repeated with a reduced discontinuity bound, resulting in an anytime, probabilistically complete, and asymptotically bounded suboptimal planner. We provide a benchmark of 65 problems with six different dynamics. We demonstrate that db-ECBS produces trajectories that are less than half the cost of existing planners. We show that the interaction-awareness is particularly important for very dense scenarios.

References

Moldagalieva, A.; Ortiz-Haro, J.; and Hnig, W. 2026. db-ECBS: Interaction-Aware Multirobot Kinodynamic Motion Planning. *IEEE Transactions on Robotics*, 42: 244–260.