Joint Path and Push Planning among Moveable Obstacles

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Abstract : This paper explores the navigation among movable obstacles (NAMO) problem and proposes joint path and push planning: which path to take and in what direction the obstacles should be pushed at, given a start and goal position. We present a planning algorithm for selecting a path and the obstacles to be pushed, where a rapidly-exploring random tree (RRT)-based heuristic is employed to calculate a minimal collision path. When it is necessary to apply a pushing force to slide an obstacle out of the way, the planners leverage means-end analysis through a dynamic physics simulation to determine the sequence of linear pushes to clear the necessary space. Simulation experiments show that our approach finds solutions in higher clutter percentages (up to 49%) compared to the straight-line push planner (37%) and RRT without pushing (18%).