MAPP: a scalable multi-agent path planning algorithm with tractability and completeness guarantees.


The article addresses the problem of multi-agent path planning where vehicles of uniform size and speed move in an undirected graph from a start node to a destination node. The presented MAPP algorithm is complete for so-called “slidable” graphs and has a proven low-polynomial upper bound on its runtime. Its runtime behavior lies in between known incomplete algorithms such as FAR and WHCA*. The length of the computed solutions is approx. 10 to 30% longer than those produced by FAR and WHCA*, but MAPP solves more instances than those algorithms. MAPP introduces several novel concepts for computing vehicle paths and a technique to reuse intermediate computations, which allow it to avoid replanning. Several extensions of the base algorithm are presented that relax the introduced notion of a graph being slidable leading to more classes of graphs to which the algorithm is applicable. Comprehensive experiments complement the theoretical results and provide deeper insights into the practical behavior of the algorithm on large benchmarks.

Keywords: multi-agent path planning; undirected graph; centralized search
doi:10.1613/jair.3370