"Multi-Agent Path Finding: from Theory to Practice" Students Project

Computational Robotics Lab (CRL)

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1 Background

In Multi-Agent Path Finding (MAPF), we are given a graph $\mathcal{G}(V, E)$, and a set of N agents labeled $\{a_1 \dots a_N\}$. Each agent a_i has a start location $s_i \in V$ and goal location $g_i \in V$. At each time step, an agent can either move to a neighboring location or can wait in its current location. The goal is to return a set of collision-free (with other agents and obstacles) paths from s_i to g_i for each agent a_i, such that the overall cost is minimized. A common cost function is the number of time steps required for the agent to reach the goal location, summed over all agents. MAPF has practical applications in robotics, video games, vehicle routing, and other domains.

2 The Project

In this project, the student will learn and fully understand an algorithm called Conflict Based Search (CBS) [1]. CBS is an algorithm that solves the MAPF problem and returns an optimal solution. In common CBS scenario, we assume that the agent (robot) is a *point robot*, meaning, it can either go up, down, right, or left *without the need of turning*. Therefore, at every time step of the plan the algorithm account only for the robot location: (x, y).

This assumption does not always hold in real-life, many robots can move to a direction only if they face it.

In this project, the students will extend CBS algorithm to account not only for the location of the robot in each time step but also for its orientation θ. As a result at each time step, an agent can either move to a neighboring location, wait, or *turn*. This solution will produce a plan for a real-life scenario that vanilla CBS does not handle.

References

[1] Guni Sharon, Roni Stern, Ariel Felner, and Nathan R Sturtevant. Conflict-based search for optimal multi-agent pathfinding. *Artificial Intelligence*, 219:40–66, 2015.