MEAM 620 Project 3A

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1 Description of Problem and Associated Algorithms

1.1 CAPT

The concurrent assignment and planning of trajectories problem, or CAPT, involves finding a method of assigning N homogeneous robots to M goals and generating collision-free paths in order to reach the goals. The linear assignment portion of this problem may be offloaded to the Hungarian Algorithm, which is of complexity order $\mathcal{O}(N^3)$. Robots are generally assumed to be point-set objects in a ball of radius R.

1.2 C-CAPT

C-CAPT is a centralized solution to the CAPT problem, via which trajectories are minimized via a cost functional encompassing valid assignment, resource utilization (with respect to the assignment matrix), initial conditions, terminal conditions, robot capabilities (the dynamics of each robot, generally assumed to be first-order), and collision avoidance.

1.3 D-CAPT

2 Implementation and Runtimes

2.1 C-CAPT (2D)

2.2 C-CAPT (3D)

2.3 D-CAPT

2.4 D-CAPT Examples

Figure 1: Example #1 Using C-CAPT

Initial State | End State

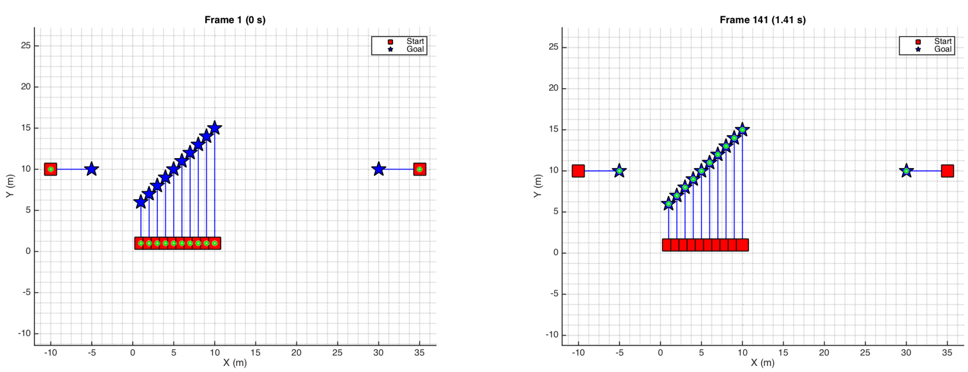


Figure 2: Example #1 Using D-CAPT

Initial State | End State

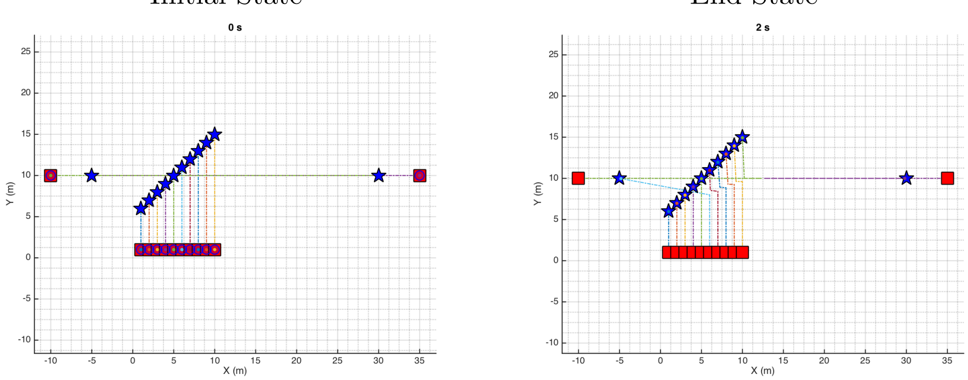


Figure 3: Example #2 Using D-CAPT

Initial State End State

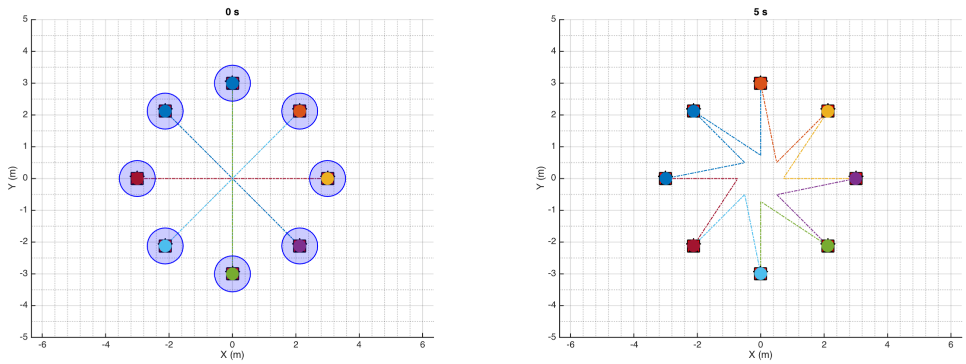


Figure 4: Example #1 Using D-CAPT

Initial State End State

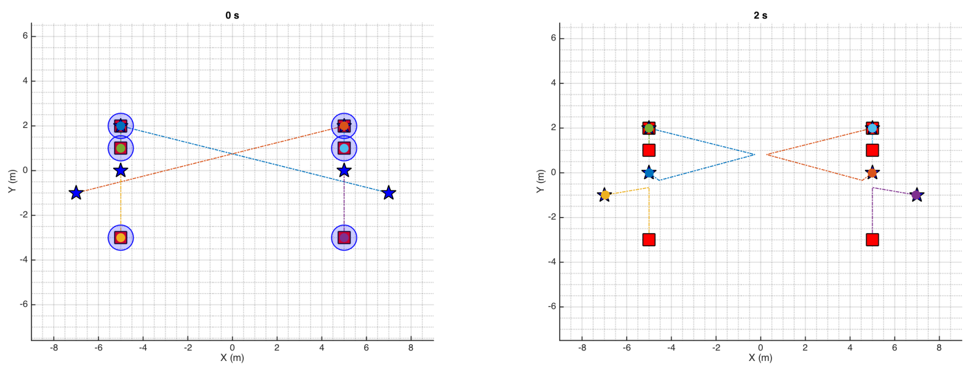
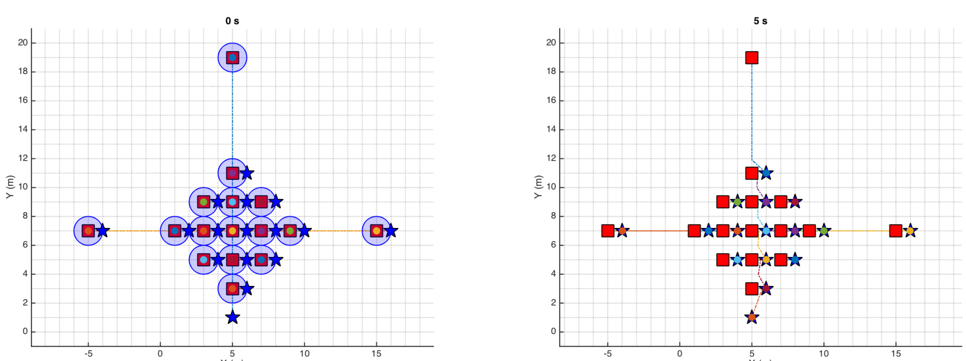


Figure 5: Example #1 Using D-CAPT

Initial State End State



These three examples show the main drawback of D-CAPT compared to C-CAPT, which is that since points are not assigned optimally at the start, there can be extremely non-optimal paths. Other drawbacks include that the number of robots must equal the goal points (however we implemented a small extension to allow this), the inital assignment problem must be unique without a centralized controller, and that networking and precedence creates a leyer of complexity in robot-to-robot communication.

3 Interesting Examples

4 Further Possible Work