Wildfire

The obstacle field is filled with obstacles in shape of tetrominoes and covering 20% of the 250*250 grid.

Combinatorial Planner Implementation

We are using Hybrid A* for the combinatorial planner. We used hybrid A* implementation from Valet assignment to extinguish subsequent fires. The firetruck is given the next goal when it extinguishes the current targeted fire.

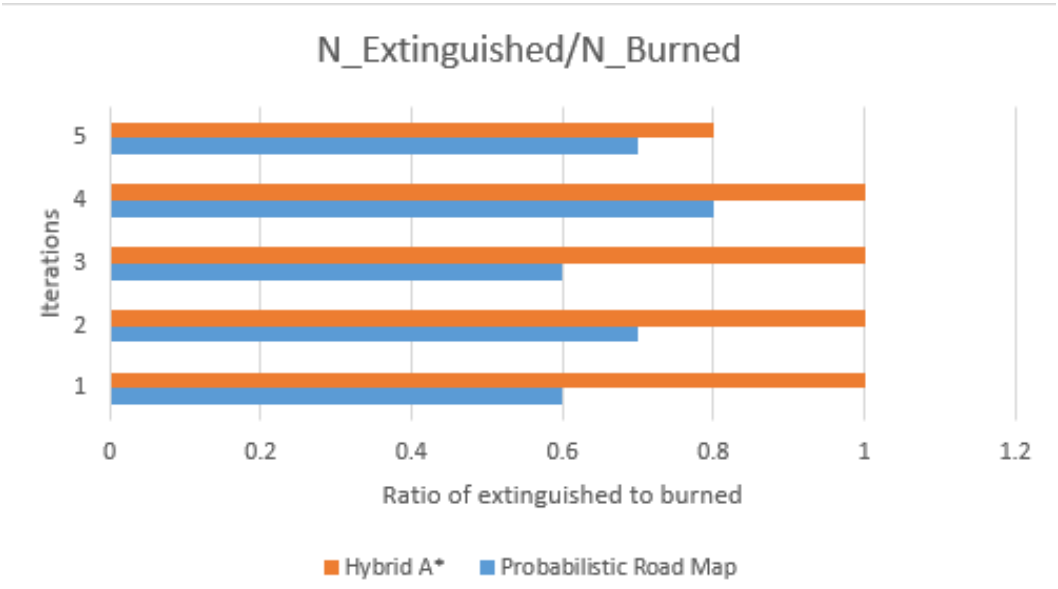
Sampling-based planner implementation

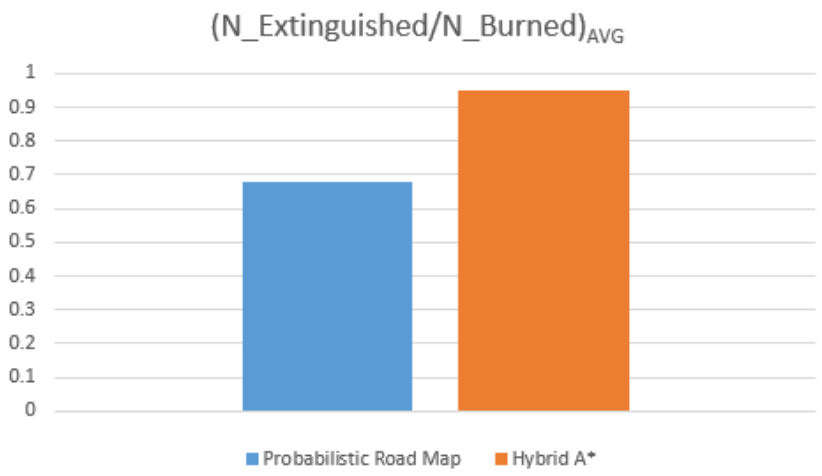
We use a Probabilistic Road Map with a local path planner to achieve this. We first sample nodes to form a road map then use Dijkstra's Algorithm to get the final path. To connect the nodes we use Hybrid A* as the local planner which also takes into account the kinematic model of the car i.e. firetruck in this case.

Comparison

We find the ratio of number of extinguished obstacles to number of burned obstacles and also average it over the 5 iterations to obtain the following comparative graphs:
Average values for $N_{extinguished}/N_{burned}$:

Hybrid A* = 0.95
Probabilistic Road Map = 0.68

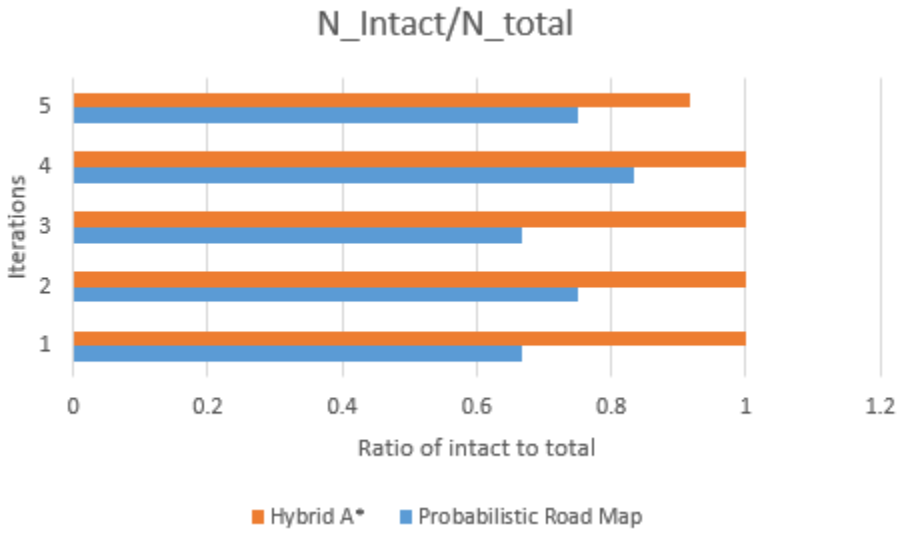


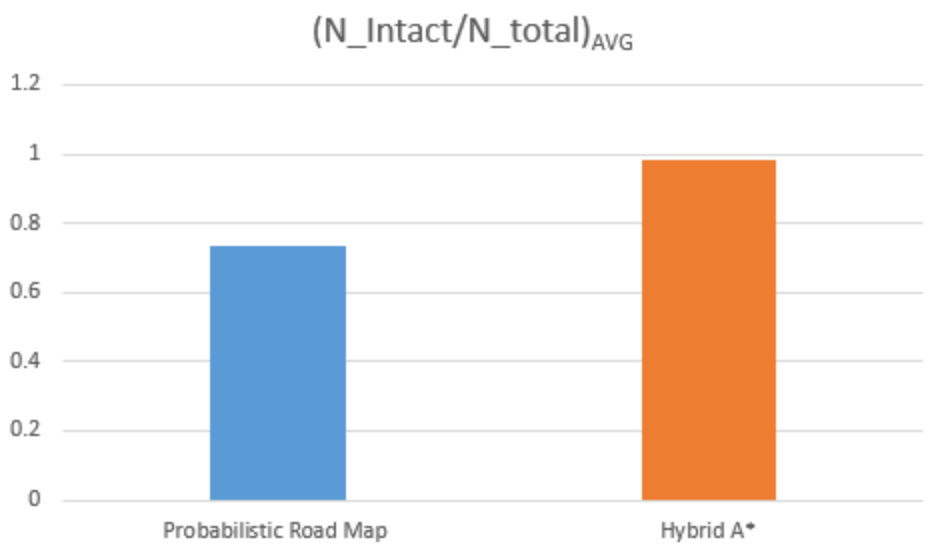


We also find the ratio of total intact obstacles to total obstacles in the grid. We also average it out for all the five iterations:

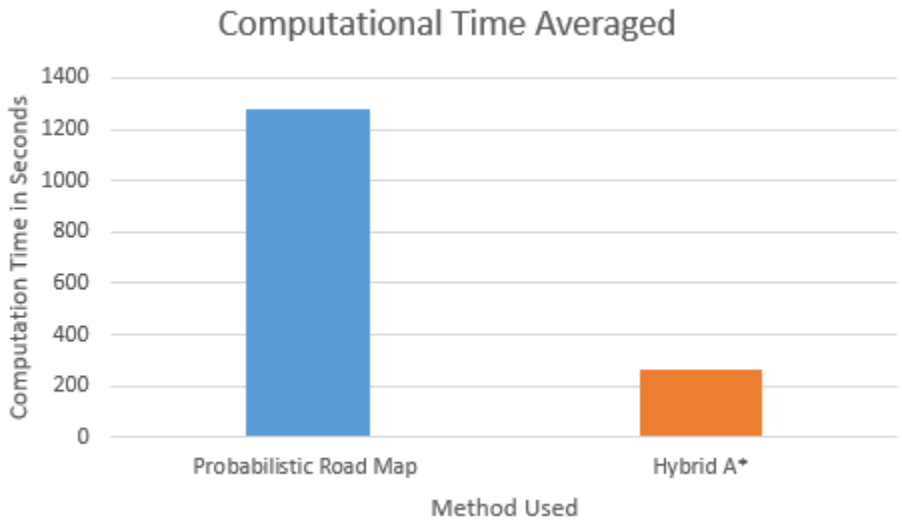
Average values for N_{intact}/N_{total}:

Hybrid A* = 0.98
Probabilistic Road Map = 0.73





The average computational time for both the implementation were as follows:
Computational Time in seconds
Hybrid A* = 267.61
Probabilistic Road Map = 1281.94



As our PRM computation was too taxing for our computer we did this comparative study over 5 iterations with simulation running for 120 secs.

For an environment like ours our Hybrid A* implementation performs way better than the Probabilistic Road Map as we can see above. But this can also be due to the limited search space 250*250 and unoptimised sampler algorithm. As this search space increases in size PRM would start performing better than Hybrid-A* as it does not have to parse the entire map every time a new goal is assigned to our subject.

In the videos submitted with this report we can see that Hybrid A* i.e. combinatorial planner plans a more efficient path than Probabilistic Road Map i.e. sampling based planner. Furthermore, having a roadmap computed a priori we significantly decrease the computation cost as we can repeatedly use the same roadmap rather than traversing and finding the optimal path in the whole map each time.

A few notes for the submitted videos:

- As the new obstacle is lit up every 60 sec, if our planner extinguishes the previous fire before the 60 sec interval we don't have to wait for the next obstacle. There will be an instant skip to the next n*60 th sec mark and the next obstacle is lit up. Due to this as our Hybrid A* extinguishes the fire at the 70 sec mark the next skip would lead to 120 sec, hence our on of our video stops at the 70 sec mark for the Hybrid A* planner.
- The simulation is for 120 sec but we don’t penalise our methods with the new fire that is set up at the 120th sec. Hence we can say the simulation is for 119.9 sec.