Project Proposal

Hierarchical Approach to Path Planning Algorithm Based on Obstacle Clustering and Graph Search

Our proposal is centered around the paper Wang, L.; Sun, L. Path Planning Algorithm Based on Obstacle Clustering Analysis and Graph Search. Symmetry 2023, 15, 1498. https://doi.org/10.3390/sym15081498. This paper proposes a graph search path planning algorithm that is based on map preprocessing for creating a weighted graph in the map, thus obtaining a structured search framework. The algorithm, say BaseAlgo, is structured as follows-

1. Use DBSCAN to cluster obstacle points to form obstacle clusters
2. Use obstacle detection algorithms to construct a graph around the obstacles, where each edge of the graph represents a path from one obstacle to another(or from start to goal state). In case if the path from one obstacle to another is not straight forward, i.e. there are some obstacles in the straight line connecting the two, then use A* to find an alternate shortest path
3. After constructing a weighted graph, use shortest path algorithms for weighted graphs.

One shortcoming of their work which they have also mentioned was that it was not scalable, as they were struggling with cases with large maps and/or many obstacles. Therefore our approach is as follows.

1. First divide the map grid to a smaller grid by clubbing small grids to form bigger grids. For example we convert a 100x100 map to a 10x10 map.
2. We also transform the obstacles in the 100x100 grid to an appropriate form for the 10x10 grid.
3. Use BaseAlgo on the smaller grid and get a shortest path P(with respect to the smaller grid)
4. Then only expand the subgrids which occur on the path P and use BaseAlgo on these expanded subgrids.

In this way we can effectively decrease the search space to a smaller amount. This approach is similar to Hierarchical A*(HPA*), where we also divide a map into smaller submaps, use A* to find the optimal path through these submaps, and then again use A* to find the optimal path through these selected submaps.

The novelty of our proposal lies in the fact that we are planning to augment a very recently published paper using a heuristic which makes sense intuitively. Step 2 in our planned algorithm is also non trivial as it is not straightforward to transform obstacles while making subgrids. If we are able to get good results then it would be a big improvement for cases where the pre existing algorithm BaseAlgo is not performing well.