Dynamic weighted Multi Heuristic A*

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1 Overview

Heuristics are simple, efficient rules which people often use to form judgments and make decisions. The performance of heuristics based search algorithms depends on how well the heuristics is designed. However, for many domains, it is hard to design a single heuristic function that is able to perform efficiently. An admissible heuristic guarantees optimality whereas a goal-directed heuristic leads to faster solutions. Unfortunately, designing heuristics that are both fast and admissible is often challenging. To address this, we would like to put our efforts in a direction where we develop an algorithm which is dynamically able to switch between multiple heuristics or assign appropriate weights to the heuristics in order to find the best of the two worlds.

2 Problem Formulation

Peter Hart, etc [2] first described the algorithm in 1968, achieves better performance by using heuristics to guide its search. Where A* selects the path that minimizes:

$$f(n) = g(n) + h(n)$$

, where n is the last node on the path, $g(n)$ is the cost of the path from the start node to end node, and $h(n)$ is a heuristic that estimates the cost of the cheapest path from the start node to the goal. Since the performance of heuristic search based planners depends heavily on the quality of the heuristic function used to focus the search. Our goal in this project is to find a better heuristic function or combination of a series of heuristic function to better the iteration steps of the program.

2.1 Concise definition of the problem

2.2 Algorithms

The baseline algorithm will be the A* algorithm running with a scheduling algorithm which decided what heuristics to run. We would also like to do the analysis of different combinations of heuristics and compare them in order to find the optimal setting for the given problem.

2.3 References of the existing work

Aine. etc [1] presented a heuristic search framework (MHA*) that uses multiple inadmissible heuristics to simultaneously explore the search space, while preserving guarantees of completeness and sub-optimality bounds using a consistent heuristic. [3] presented an algorithm that dynamically generates heuristics to avoid local minimal in search-based planning.

3 Proposed Timeline

- Week 1 and 2: Exhaustive search of the existing work and a concise problem formulation whether to improve the state of the art algorithms or develop a new one.
- Week 3 and 4 : Design and implement the algorithm.
- Week 5 and 6 : Do analysis and collect results..

4 Individual Responsibilities

While implementing the proposed algorithm, Zhongshun would work more on the mathematical analysis whereas Nahush would focus on implementation side.

References

[1] Sandip Aine, Siddharth Swaminathan, Venkatraman Narayanan, Victor Hwang, and Maxim Likhachev. Multi-heuristic a. *The International Journal of Robotics Research*, 35(1-3):224–243, 2016.

[2] Peter E Hart, Nils J Nilsson, and Bertram Raphael. A formal basis for the heuristic determination of minimum cost paths. *IEEE transactions on Systems Science and Cybernetics*, 4(2):100–107, 1968.

[3] Fahad Islam, Venkatraman Narayanan, and Maxim Likhachev. Dynamic multi-heuristic a. In *Robotics and Automation (ICRA), 2015 IEEE International Conference on*, pages 2376–2382. IEEE, 2015.