BABIT*:a Bidirectional Advanced BIT* for Fast Path Planning with Implicit Random Geometric Graph

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***Abstract*—Path planning is an active and essential research field for many applications with autonomous mobile robotics.This paper proposes a Bidirectional Advanced Batch Information Tree (BABIT*), which is an asymptotically optimal algorithm path planner enhanced from Batch Information Trees. BABIT* promotes the exploration of the entire state space by adopting a more reasonable sampling strategy and ensures faster discovery of solutions by using symmetric bidirectional search for the state space. The experimental results show that BABIT* outperforms existing sampling based planners on the tested problems.**

***Index Terms*—path planning, sampling-based planning algorithms, asymptotically optimal planning**

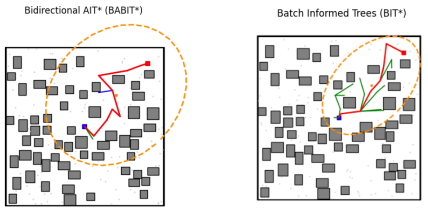
I. Introduction

Popular techniques for path planning include graph based search methods and sampling based methods, however with limitations in the situations where on-board computing is required for robots to work on their own. Those methods will spend more on calculation due to the need for environmental discretization and random sampling respectively.

Therefore, this paper proposes a bidirectional advanced batch information tree (BABIT*) enhanced from BIT*[1].

II. Method

BABIT* maintains a gradually dense implicit random geometry graph (RGG) through batch sampling to obtain an approximation of the environment, similar to ABIT*[2]. BABIT* uses bidirectional search to extend two trees,and if there is a connection between two trees, it will generate a solution.



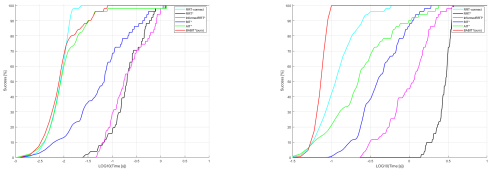
(a) BABIT* (b) BIT*

Fig. 1: Results for BABIT* and BIT* in 2D.

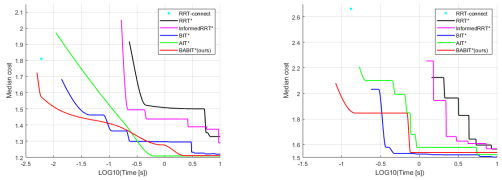
When searching for the initial solution, BABIT* uses subdomains of the state space for sampling to obtain more uniformly dispersed approximations. In addition, due to searching in both the starting and target directions, BABIT* can quickly obtain the initial solution and achieve convergence, as the notification area appears earlier. After finding the initial solution, BABIT* will conduct sampling within the notification area to find the best solution to the current planning problem.

III. Experiment & Conclusion

To test the performance in different problems, BABIT* compared with RRT-Connect, RRT*, Informed RRT*, BIT* and ABIT*. The goal of these simple optimal planning algorithms is to minimize path length.We set parameters based on the experimental design in [1] and tested these planners using 2D and 3D random environments.



(a) 2D: Success rate vs. time (b) 3D: Success rate vs. time



(c) 2D: Median cost vs. time (d) 3D: Median cost vs. time

Fig. 2: Results from different planners in 2D and 3D.

These experiments indicate that in 2D (Fig. 1a, 1c) and 3D (Fig. 1b, 1d), BABIT* typically finds better solutions faster than other sampling based optimal planners. Compared to these planners, it has a higher likelihood of finding a solution within a given computational time and converges to the optimal value faster. We conducted the same test using raspberry pie and the results showed that BABIT* was also able to find the initial solution faster compared to other planners.

References

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