Title:

Multi-Objective Path Planning

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Scientific Summary:

All of the classical path planning approaches such as road map, decomposing, potential fields, have own advantages and disadvantages, but generally they have a common weakness: they take into account only a single goal of PP. Most of these methods focus on the length of the path and consider the 'shortest path' (a path which has minimum length between source and destination points) as the optimal path. Other methods search a 'safe path' (a path with maximum distance from obstacles), or a 'smooth path' (a differentiable path studied in the continuous space). While in real applications the optimal path is a combination of all of these terms. This discussion was introduced as 'natural-looking path' in the study of Wein [1] where two objects, VG and VD, are combined and a new object called Visibility Voronoi diagram was extracted. Constructing visibility Voronoi diagram is very complicated in higher dimensions; especially it has an exponential complexity with respect to the space's dimension. Also, some studies like [2, 3] tried to achieve the safety goal using Minkowski sum, or to achieve smoothness goal using a post-process on the output of sample-based methods. Unfortunately, none of these techniques don't guarantee the optimality terms after post-processing. Furthermore, they are inefficient in the higher dimensions, clutter and corridor spaces [1].

In general, there are few studies in PP literature which take into account all optimality's aspects simultaneously such as [4]. This method provided a single objective optimization based on the linear combination of all objectives. However, this is a familiar technique in the optimization literature and it suffers significant disadvantages, namely there is no exact information about the priority of the objectives, and also there is no proportion between the objective space and the weighted space, especially in the non-diverse search space.

Variety of the multi-objective path planning problem:

In this project we focusing on multi-objective path planning problem using geometric, heuristic and/or randomized approaches. However, there are also several general parameters in the problem such as follows:

- Defining objective(s) regarding to the application (Shortness, Clearance, Smoothness,…)
- Continuous or Discrete Work Space,
- Robot's Dynamics, Robot's abilities and Constraints

References

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[4] A. Elshamli, H. A. Abdullah, S. Areibi, Genetic Algorithm for Dynamic Path Planning, CCECE 2004 – CCGEI 2004, Niagara Falls, May 2004 IEEE.