Project ID: 371

SR - Mathematics

Derek Liu

Arrangements of Simplices in Fine Mixed Subdivisions

A regular simplex of side length n can be subdivided into multiple polytopes, each of which is a Minkowski sum of some faces of a unit simplex. Ardila and Billey have shown that exactly n of these cells must be simplices, and their positions must be in a “spread-out” rrangement. In this project, we consider their question of whether every spread-out arrangement of simplices can be extended into such a subdivision, especially in the three-dimension case. We prove that a specific class of these arrangements, namely those that project down to a two-dimensional spread-out arrangement, all extend to a subdivision.

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SR - Mathematics

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Multi-Resolution, Multi-Heuristic, Polynomial-Based, A Motion Planning With Semantic Consideration*

Robotics control is often divided into four categories: mapping, localization, path planning, and control. Recent innovations related to path planning often center around search-based planning, which search a given environment for an optimal route, where optimality could be defined by time, distance, or smoothness. However, most sampling planners are based on a grid format and fail to take into account the kinematics of the robot. Prior works have investigated the used of curve-based search planners. However, these planners suffer from high computation expense. Thus, in these slides, I propose a curve-based motion planner with multi-resolution, multi-heuristic, and semantic-based planning, allowing for the benefits of curved planning to be realized without the expense of traditional curve planning. By sampling constant acceleration control at multiple resolutions, the state space, all possible velocity and positions of the robot, can be sampled faster, allowing for the rapid generation of a curved trajectory, incorporating the kinematics of a mobile robot. In randomly generated environments and environments with large obstacles, the algorithm demonstrated promise in quickly determining a viable curve solution. Moreover, when these solutions were provided to a mobile robot platform in physics simulation, the robot was able to rapidly follow the solution set of curves while avoiding all obstacles. Robots are becoming more prevalent in daily activities ranging from autonomous cars to drone delivery systems. The proposed algorithm would augment the performance of these robots, making autonomous potentially more prevalent on a broad scale.