Paper ID: 68680
oral
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IAF SPACE SYSTEMS SYMPOSIUM (D1)
Interactive Presentations - IAF SPACE SYSTEMS SYMPOSIUM (IPB)

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MOTION PLANNING OF SPACE ROBOT BASED ON GAT

Abstract

The activities of astronauts are restricted by the space environment during on orbit servicing, and it has become the unanimous goal of all countries to make up for this deficiency with space robots. Due to sensor errors, unknown and dynamic changes of the environment in operating tasks, it is necessary to quickly adjust the currently planned path of space robot, that is, fast motion planning of space robot. For planning algorithms like Informed RRT*, which is optimized based on the initial solution, a high-quality initial solution can accelerate the convergence and achieve fast motion planning. However, the quality of the initial solution is closely related to the sampling distribution in the solution process, making the optimal motion planning sensitive to the sampling distribution, and it is difficult to guarantee the quality of the initial solution and the time it takes to converge to the optimal solution. To overcome these limitations, we propose a novel optimal path planning algorithm based on GAT (Graph Attention Network), namely GAT-Informed RRT*. The GAT-Informed RRT* utilizes a nonuniform sampling distribution generated from GAT-CVAE (Conditional Variational Auto-Encoder). The model is trained using quantities of successful path planning cases. In this article, we use the RRT* algorithm to generate the training data set consisting of the map information and the optimal path. For a given task, the proposed GAT-CVAE model can predict the probability distribution of the optimal path on the map, which is used to guide the sampling process. The simulation results reveal that the proposed method can improve the quality of initial solution and accelerate the convergence to the optimal solution.