Graph Generation Using Point Cloud Data for Path Planning of Autonomous Mobile Robots

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***Abstract* - Mobile robots used in public spaces require safe path planning, such as avoiding obstacles. In this paper, we propose a method of generating a drivable path in a graph from a drivable region excluding moving obstacles, small obstacles, regions such as grooves and slopes that hinder traveling by LiDAR. Then, the effectiveness of the proposed method is shown by experiments.**

Keywords - 3D LiDAR, 3D map, self-localization, dynamic environment, mobile robot.

I. Introduction

3D maps are useful for safe path planning of mobile robots. A 3D map is a map represented by point cloud data. However, a general map does not include moving objects such as pedestrians. In addition, a slight groove or a steep slope hinders the robot from traveling. When planning a path, it is necessary to understand the shape of the running surface and avoid these areas.

Therefore, in this paper, we propose a method for planning a path that can run using a graph by removing points that may obstruct the running such as small obstacles and grooves on the running surface from the point cloud data in the local space.

II. Proposed Method and Experimental Result

The measured point cloud is shown in Fig.1. Fig.2 shows a graph created from the point cloud and an image of the planned path.

First, the self-localization is executed by aligning the point cloud data of the 3D map with the newly measured point cloud data [1]. Next, based on the self-localization, the point cloud space in front of the robot is divided into voxels, and the running possibility in the voxel space is determined from the floor inclination estimated from the local point cloud data in the voxels and the missing information. Finally, runnable voxels are replaced with nodes, and a graph in which adjacent nodes are connected is created. The graph is searched to generate a travelable path to the destination.

Fig.3 shows an example of the experimental results. It can be seen that the route can be planned by creating a graph excluding the area with obstacles.

III. Conclusion

We proposed a method to create a graph for path planning of a mobile robot from point cloud data. With the proposed method, we could plan a path that considers the possibility of running, but whether it can actually run depends on the size of the robot. For safer navigation, we plan to improve the method to consider the size of the robot in the future.

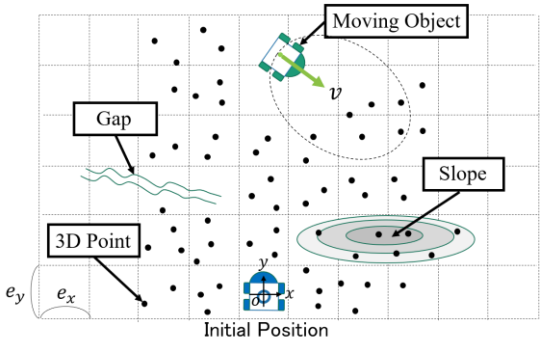


Fig.1 The measured point cloud.

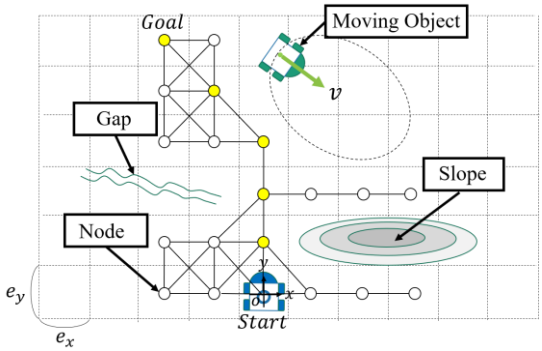
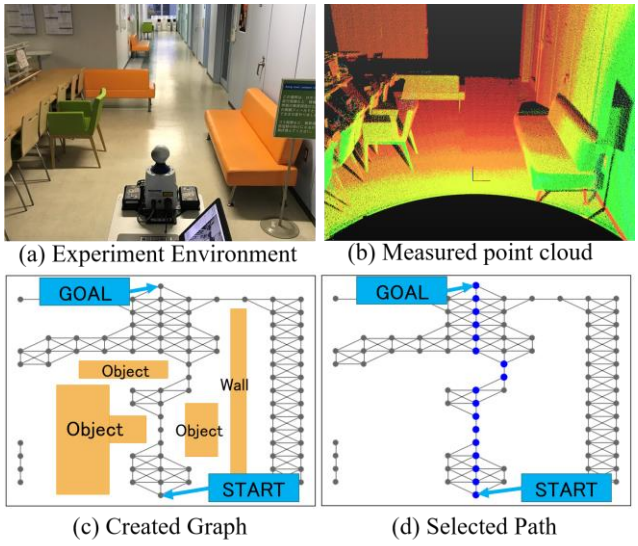


Fig.2 A graph created from the point cloud and an image of the planned path.



(a) Experiment Environment (b) Measured point cloud

(c) Created Graph (d) Selected Path

Fig.3 An example of the experimental results.

Reference

[1] Tsuyoshi Amano, Isao Miyagawa and Kazuhito Murakami, "Iterative Update Method of 3D Map Based on Self-Localization Using Multi-Layer NDT in Dynamic Environment", Proc. of IWAIT2019, Singapore, 2019/1/8.