Building Wall Extraction Method using Land Registration Map Image

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Abstract – Digital map can be a good materials for some robotic problems such as localization, segmentation, classification, SLAM algorithm. In this paper, we propose building wall extraction algorithm from land registration map image using corner, edge detection methods and simple matching approach. Experimental results show that this algorithm is valid for general land registration map.

Keywords – corner detection, land registration map, wall extraction, segmentation.

1. Introduction

If robots are to move in the real world they need to be able to keep track of their position. For this they need maps. We want robots to be able to learn these maps as they move about the environment. Many of sites provide satellite map image or land registration map such as maps.google.com, openstreetmap.org, map.naver.com. This digital map can be a good materials for localization if uses several matching methods. It is difficult to get accurate GPS position due to the blackout or multi-path phenomenon of GPS particularly in urban environment. This also can be a great help in the segmentation - classification problem [1] of 3D point clouds. But land registration map is just simple image, it is required to extract meaningful information such as road or building wall. In this paper deals with an approach for extraction of building wall that uses topographic map image.

A. Related Works

Several researches already used satellite map image or digital map for solving localization and mapping problems. In [2] combines stereo camera images, visual odometry, satellite map matching, and a sidewalk probability transfer function obtained from street maps in order to attain globally corrected localization results.

And [3] based on a stereo platform used to estimate the motion trajectory of the ego vehicle and a map-matching algorithm, which will correct the cumulative errors of the vision-based motion information and estimate the global position of the vehicle in a digital road map.

Another localization related method [4] matches a local point map (acquired e.g. with a laser range finder) to a global map. This approach makes a discrete search using a best-first branch and bound method to efficiently compute the globally optimal pose estimate. Furthermore, there is case that apply to the SLAM problem [5].

2. The Proposed Method

Most of the buildings are erected vertically on the ground. If we can classify different color of the ground, roof and boundary of the building in map image, we can distinguish the location of the building wall easily. Also land registration map represents the boundary wall of the building with darker color; walls of the building can be extracted easily.

2.1 Corner Detection

Line segments consists of two points. In terms of memory efficiency and ease of matching methods, managing of corresponding two points is better than taking all of edge points. We use [6] corner detection algorithm for initial corner points extraction and use our proposed \( N - \theta \) perpendicular pattern matching method for finding accurate building corner points.

2.2 Matching with Edge Image

Using the extracted corner points, we can find corresponding two points that consist line segment through matching with edge image as seen in Fig. 1.

Fig. 1. Illustration of corner-edge matching method
Correspondence can be determined by the average intensity of pixels on lines of every extracted corner points. If lines are on building wall, the average intensity level is high enough.

3. Experimental Result

We have tested on the google map and naver map to validate our proposed approach. We used 1920 x 1920 (480m x 480m region) image size for this experiment. Fig. 2 shows the extraction procedure of our proposed method.

Table 1 represents the success rate of our proposed method of building wall extraction. We use 2 datasets for this experiment and has over 90% success rate.

![Fig. 2. Extraction procedure by proposed method (KAIST dataset). (a) Land registration map raw Image. (b) Edge detection result. (c) Extraction result. (d) Result display by 3D space.](image)

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Total walls</th>
<th>Extracted</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAIST (naver map)</td>
<td>276</td>
<td>262</td>
<td>94.93%</td>
</tr>
<tr>
<td>Downtown (google map)</td>
<td>198</td>
<td>181</td>
<td>92.41%</td>
</tr>
</tbody>
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4. Conclusion

In this paper we propose building wall extraction method using land registration map image. This extracted building wall can be a good materials for localization or segmentation - classification problem.

Future work includes the applications of the localization framework or segmentation problem. Moreover, enhanced version which reuses this accuracy to localization algorithm like SLAM framework will be one of our future research areas.

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References