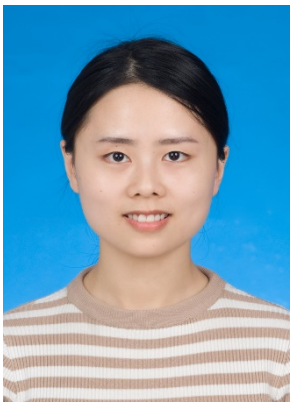
Combine laser scan data with OpenStreetMap to produce a three-dimensional map

(Master Thesis)



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Motivation

The eNav system serves as a barrier-free route planning system for (electric) wheelchairs. To enable accessible routing, OpenStreetMap(OSM) is used as a main source of base map. However, the height information indispensable for eNav is only sparsely available in the OSM-maps, therefore, these maps are needed to be extended with laser scan data, which is provided by the municipality of Aachen. This combination produces a three-dimensional map and allows the calculation of the incline information at every edge, which helps to calculate the most energy-efficient route and to determine whether the battery level of the wheelchair suffices to bring people to their destination.

State of the Art

eNav is a barrier-free route planning system for the disabled, it uses OpenStreetMap (OSM) as a main source of base map and larser scan data as extention of height information, which are the data input to compute the most energy-efficient route between two points.OSM is a collaborative project to create a free editable map of the world. However, the height information significant for eNav is only sparsely and inaccurately available in the OSM with accuraccy only 5 meters.This crucial height information with which the OSM are enriched is provided by laser scan data; This data is acquired during an earth surface scanning done by an airplane using laser tracking with a frequency of approximately 200 kHz; it has an accuracy of ±20cm, which suffices for the route calculation used in eNav.

Goals

The goal of this work is to combine the data in base map with the laser scan data to produce a three-dimensional map and to calculate the incline information at every edge. The main problem is that in some cases we cannot obtain data's height from laser scan data directly, for example, some obstacles such as bridges and cars will hide the road so that there is no height information about these points in laser scan data. Our goal thus is to solve this problem and to help calculate the energy-efficient route in eNav.

Implementation

In this work, we will develop a technical solution to obtain height information from Aachen laser scan data and to produce a three-dimensional map. Then we will calculate the incline information at every edge. The way to combine laser scan data with the OSM is to match every road node in these two datasets. Firstly, we select the neighborhood points in laser scan data of a road node in OSM. After that we extract clusters of these neighborhood points and then cull unwanted clusters which are far away enough from the road; Finally, we classify remained clusters and obtain the height information with finding the road clusters in laser scan data. In this stage, we will develop an algorithm to calculate the height of hidden road datasets according to different obstacles.

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