Iterative Snapping of Odometry Trajectories for Path Identification

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Abstract. An increasing number of mobile devices are capable of automatically sensing and recording rich information about the surrounding environment. Spatial locations of such data can help to better learn about the environment. In this work, we address the problem of identifying the locations visited by a mobile device as it moves within an indoor environment. We focus on devices equipped with odometry sensors that capture changes in motion. Odometry suffers from cumulative errors of dead reckoning but it captures the relative shape of the traversed path well. Our approach will correct such errors by matching the shape of the trajectory from odometry to traversable paths of a known map. Our algorithm is inspired by prior vehicular GPS map matching techniques that snap global GPS measurements to known roads. We similarly wish to snap the trajectory from odometry to known hallways. Several modifications are required to ensure these techniques are robust when given relative measurements from odometry. If we assume an office-like environment with only straight hallways, then a significant rotation indicates a transition to another hallway. As a result, we partition the trajectory into line segments based on significant turns. Each trajectory segment is snapped to a corresponding hallway that best maintains the shape of the original trajectory. These snapping decisions are made based on the similarity of the two curves as well as the rotation to transition between hallways. We will show robustness under different types of noise in complex environments and the ability to propose coarse sensor noise errors.

1 INTRODUCTION

Sensor-equipped mobile devices can sense and record information about their surrounding environments. Mobile devices are presented with incredible opportunities to collect data where static devices cannot. For example, a stationary thermometer is rather uninteresting because it only measures temperature at a single location. In contrast, a mobile device equipped with a thermostat could create a temperature map to reveal patterns and perhaps even identify drafty windows. Interesting spatial maps could be created from many other sensors including UV, air quality, radiation, and Wifi. Devices that move can help reveal