

Using Digital Maps in Road-Constrained Vehicle Navigation

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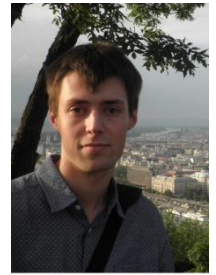
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Abstract: Satellite-based vehicle navigation is a ubiquitous necessity in urban areas and integrity in positioning is paramount. Land vehicles in urban environments are generally confined to metropolitan road networks therefore digital road map information can be a useful resource in vehicle positioning. We investigate the effect of using digital road maps to aid vehicle tracking and positioning performance in terms of error reduction in a variety of circumstances, and briefly discuss the theory of how best to implement digital road map data into a filtering algorithm.

Introduction

Since the 1980s the use of digital road maps to assist satellite positioning has become an integral part of road-constrained vehicle navigation. A key question remains to be comprehensively answered: exactly how *much* do (accurate) digital road maps improve road vehicle navigation, and how do factors such as non-linear road geometries, model errors and GPS outages affect this improvement?

Methodology

We answer the focus question using data generated from computational experiments (simulations). Using computational models to generate GPS and vehicle position data, the aforementioned parameters may be appropriately varied.

Computational experiments involve synthetically generated vehicle traversals of various road network features such as straight sections, corners, U-turns and intersections. In the map-assisted cases, position estimation is constrained to the network, else it is unbounded. We compare estimation errors for these two cases.

Discussion

Simulation results consistently demonstrate that road map information reduces positioning error by at least a factor of 2 (greater when complex maneuvers are involved). This is true even if the model parameters used are not correct, and for all common road geometries tested. In addition, this error reduction factor is much greater during GPS outages over non-straight road sections.

Example Comparison of Map vs No-Map Filters

