Localization confidence domains via set-inversion on short-term trajectory

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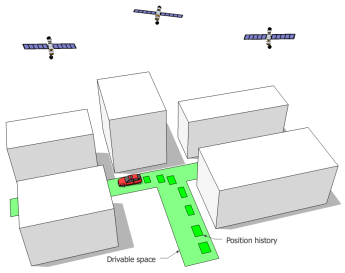
Abstract

The knowledge of localization uncertainties is of prime importance when the navigation of intelligent vehicles has to deal with safety issues. This paper presents a robust estimation method able to quantify the localization confidence based on interval analysis and constraint propagation.

Firstly, tightly-coupled position domains are computed by constraint propagation on GPS measurements and a precise 3D map of the drivable area. Since GPS is prone to satellite masking and wrong measurements in urban areas, a second stage provides localization integrity and information availability, by the use of a position and proprioceptive data history. A robust constraint propagation algorithm is employed to compute the current vehicle pose. It is able to handle erroneous positions with a chosen integrity risk.

Experiments carried out in urban canyons illustrate the performance of the method in comparison with a particle filter. Despite bad satellite visibility, full positioning availability is obtained and errors are less than 5.1 m during 95% of the trial. In opposition to the particle filter, confidence domains are consistent with ground truth which confirms the high integrity of the method.

Keywords: localization, sensor fusion, GPS, 3D map, integrity



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