Project Proposal

Project: Sequential Image Odometer

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Overview

The purpose of this project is to evaluate a prototype odometer based on analysis of sequential images from a downward facing camera for use as an additional sensor to augment traditional inertial navigation sensor data in poor GPS coverage situations. Elements of the project include: a feasibility study, proof of concept trials, prototype instrument design and construction, and prototype instrument calibration and validation. The goal of the project is to determine whether such an instrument has potential to reduce position uncertainty, given practical image capture rate and image processing limitations, and to determine what other factors limit performance, e.g., mechanical vibration or position problems.

*Feasibility Study*

* Determine practical limits on frame rate and image size and estimate corresponding top vehicle speed limit.
* Do simulation analysis to determine frame to frame position uncertainty as a function of image size and resolution
  + Generate a simple baseline image translation detector to run in simulation
  + Estimate compute time per image translation calculation
  + Estimate uncertainty in translation estimation as a function of image size
  + Estimate error propagation over multiple frames and relate uncertainty to distance travelled
* Deliver rough estimates for system requirements (frame rate, image size, processing rate, number of cameras) for a desired real-time performance metric (position uncertainty @ given range from last absolute position fix) or if satisfactory real time performance is not achievable, deliver requirements for post processing operation.

*Proof of concept trials*

* Use a simple system mockup, e.g., downward facing camera on a tripod and PC for data collection, to obtain a sample set of translated pairs of pavement images using a candidate camera in similar configuration to expected vehicle mounted position.
* Process images using baseline image translation detector algorithm (above)
* Estimate uncertainty in translation estimates from sample set

*Prototype design and construction*

* Transition system mockup to a vehicle mounted prototype system
* Develop procedure to obtain a matchup of high resolution GPS and odometer image data sets
* Perform a basic system test

*Prototype calibration/validation*

* Obtain a sample matchup data set for a known route with high resolution GPS data available for ground truth
* Analyze data set using post processing to generate a GPS position vs image translation computed position matchup data set
* Compare data sets and determine differences estimated errors
* Evaluate sources of error and modify prototype to improve results
* Evaluate performance of prototype system and estimate potential for a viable real time instrument.