Street Level Object Detection and Mapping

Discovery and geolocation of assets from optical street level imagery

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Motivation
• Addresses a highly relevant GIS mapping problem;
• Replaces of a costly and time-consuming manual process;
• Enables recycling of existing image data.

Problem Statement
Develop an automatic solution for discovery and geolocating (mapping) of stationary street-side objects from optical and / or multi-sensor imagery.

Potential Impact
Enable reliable asset detection and monitoring for utility companies and state agencies, facilitate 3D city planning.

Novelty of Work
• Automatic processing of complex scenes with simultaneous presence of multiple objects;
• Flexible stochastic model enables information fusion.

Fast and fully automated pipeline for asset (e.g. poles) discovery in a specified geographic area from street-level imagery:
• Convolutional Neural Network-1 trained to detect objects of interest in a Google Street View image;
• Convolutional Neural Network-2 trained to estimate depth of field;
• Markov Random Field model to merge multi-camera detections and geolocate the objects.

We have further investigated:
• Fusion of street level with LiDAR data by adding an MRF energy term;
• Use of crowdsourced data as alternative to Google Street View.

Results and Discussion
• Accurate and reliable mapping system: 95+% object detection precision and recall; 2m position (GPS) accuracy;
• Can be retrained for any type of road-side assets;
• Scalable automatic solution suitable for large study areas;
• Operates on existing optical image data.

Incorporation of further GIS and image data is facilitated by the proposed technique and leads to a higher mapping accuracy.

Future Work
• Further improve the capacity to model multi-object scenes;
• Improve the position (GPS) accuracy by incorporating GIS landmarks into scenes;
• Perform semantic analysis of multi-sensor imaging data for scene analysis;
• Explore the commercial impact of this methodology.

References