Post-doctoral position
MATIS laboratory – French Mapping Agency (IGN) - France

Visual landmark detection and matching for image-based localization

Context

This Postdoctoral position will take place within the scope of the large TerraMobilita project (a follower of the TerraNumerica project) of the French CapDigital cluster (Business Cluster For Digital Content and Services of the Paris Region) which aims at building production lines to generate automatically and semiautomatically 3D models of roadways and sidewalks from ground-based mobile mapping systems (MMS) equipped with optical imaging together with laser devices. In that scope, one technological lock is to obtain a high quality localization of the acquired data, enabling for instance robust map updating by change detection when passing several times by the same path at different dates. This high quality can be achieved using Inertial Navigation Systems (hybridating GPS, INS and odometer measurements) but at a very high cost. It impedes the exploiting or development of low-cost digitizing systems that are able to acquire renewed data with very short updating cycles to ensure the temporal integrity of the data basis. An alternative strategy is to use the optical sensors of a light device (a light mobile platform, a Smartphone or a simple camera) as positioning sub-system and to register the acquired data with respect to a reference data set that would be acquired by an infrastructure vehicle integrating a high quality localization device. Here, the infrastructure acquisitions will be performed with a mobile mapping system called STEREOPOLIS which is developed in the MATIS laboratory. The images acquired by the low-cost system can then be registered by first matching visual relevant features between both data sets, and second integrating these matches into a bundle adjustment process. The MATIS has already some experience and tools on bundle adjustment for robust registration and reconstruction of 3D visual landmarks (e.g. road markings and road signs) from multiple view imagery with sub-decimetric absolute accuracy.

Subject

In this context, the post-doc will focus on the study of matching algorithms for very precise registration of an image as well as of an image sequence. The objective is to increase the

accuracy already reached in the laboratory and in literature. In particular, we will first focus on the extraction of very precise visual features. Visual landmarks such as road markings and signs have proved their robustness, especially facing classical interest points. Other visual landmarks or more general visual features (points, lines, patches etc.) will be studied according to the precision of their localization and their repeatability.Then the main challenge will concern the geometric precision of the matching, especially facing the volume and redundancy of the manipulated data (input and reference) and their differences due to different periods of acquisition. Pure 2D-to-2D strategies may be considered, as well as 2D-to-3D ones involving the 3D reconstruction associated with the reference dataset available at MATIS. Depending on the source of the images, an initial set of solutions (e.g. given by GPS) would be available or not. In that case, the scalability of the proposal will be mandatory to deal with large segments of data.

References

B. Soheilian, N. Paparoditis, D. Boldo. 3D road marking reconstruction from street-level calibrated stereo pairs. ISPRS Journal of Photogrammetry and Remote Sensing, Volume 65, Issue 4, pp 347-359, July 2010.

B. Soheilian, N. Paparoditis, B. Vallet. Detection and 3D reconstruction of traffic signs from multiple view color images. ISPRS Journal of Photogrammetry and Remote Sensing, Volume 77 , pp 1–20, March 2013.

Torsten Sattler, Bastian Leibe, Leif Kobbelt. Fast Image-Based Localization using Direct 2D-to-3D Matching Supplementary Material. IEEE International Conference on Computer Vision, pp 667-674, 2011.

Mattern, N. Schubert, R. Wanielik, G. High-accurate vehicle localization using digital maps and coherency images. IEEE, Intelligent Vehicles Symposium (IV), San Diego, CA, 2010.

MATIS laboratory

The MATIS laboratory of the IGN, which is the French national mapping agency, is one of the leading laboratories in photogrammetric computer vision, image analysis and remote sensing applied to geospatial imagery and ground based imagery (e.g., provided by mobile mapping systems). It is composed of 30 researchers, including 17 permanent researchers. The MATIS laboratory has been involved in 3D data collection for 3D city modelling for twenty years, and makes use of several distinct methods that have been developed during this period. For more information about the MATIS please visit our website.

Profile

The candidate should have a PhD degree in photogrammetry or computer vision, with knowledge and interest in pattern recognition.
- Good knowledge of programming language (C++) is mandatory.
- Prior knowledge and experience in the fields of pose estimation and/or scalability will be a plus.
- Good spoken and written English. Knowledge of French would be useful.

Organization

Location: MATIS laboratory of the IGN, Saint-Mandé, Paris, France.
Salary: around 2200 € per month (net income), according to experience. The position is a salaried employment with the right to social benefits and paid vacations.
Duration: 18 months, to start as soon as possible.

Application procedure

Send by email **in a single pdf file** to the two contacts: a cover letter describing how your research experience is relevant to the position, recommendation letters or names of referees and a resume (including a summary of the thesis).

Contacts

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Deadline

15 April 2013