Master's internship M2

IGN UGE – LaSTIG Lab

2021

« Geolocalization of old street-view photographs using 2D and 3D information »

Keywords

Computer vision, photogrammetry, geolocalization, pose estimation, web visualization, street-view imagery.

Context

The proposed internship is part of a French research project (ANR ALEGORIA[1]) that brings together several research laboratories, including LaSTIG from IGN (the French Mapping Agency), LIRIS from Ecole Centrale de Lyon, LAVUE from University Paris-Nanterre, LIRSA from Le Cnam, the French National Archives and the museum Nicéphore Niépce. The aim of the project is to valorize the national iconographic collections which describe the French territory at different times, starting from the between-wars period until today.

The photographic collections consist of aerial multi-date imagery (e.g. postcards, old photographs – see Figure 1), acquired at different points of view: vertical, oblique and terrestrial. Despite their content richness, their documentation and spatial geolocalization remain poor or even unavailable. Hence, the ALEGORIA project aims at developing methods that will facilitate their structuring and exploitation by putting in practice automated processing methods dedicated to their indexing, interlinking and visualization.

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Figure 1: Examples of aerial (vertical, oblique) and terrestrial views addressed in ALEGORIA.

Since 2018, several innovative tools have been studied and developed in the project to visualize multi-date *aerial* photographs in a 3D environment [Blettery et al, 2020] and to georeference them

[1] ALEGORIA web site : http://www.alegoria-project.fr

(e.g. estimating the pose - position and orientation - in the 3D space of the cameras that produced them), using automatic photogrammetric methods [Blettery, 2019] [Harrach et al, 2019]. Figure 2 illustrates these realizations.

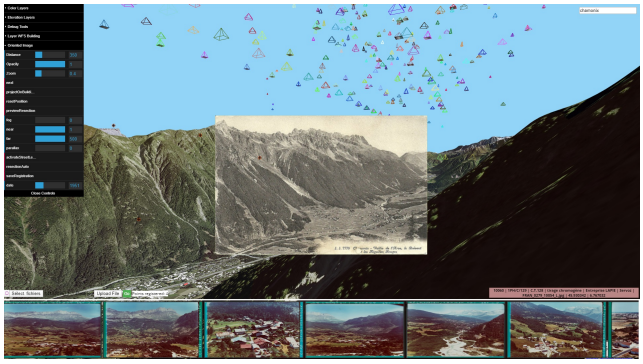

Figure 2: 3D visualization of ancient postcards geolocalized in the 3D environment, relying on iTowns, the 3D IGN Geoportal (http://www.itowns-project.org).

Subject

This internship will focus on the geolocalization process for *street-view* (terrestrial) images. They have their own specificities, not entirely addressed with the ALEGORIA tools already developed for aerial imagery, such as the more present occlusions as well as the great proximity of the camera to the scene and the 3D associated models that may induce distortions and sensitivity to the models precision. The main objective of the work will consist in exploiting the 2D and 3D data available, given by images, 3D point clouds (LiDAR data) and 3D building models, to improve the geolocalization process of street-view images and apply it to ancient photographs.

In the state of the art, the task of automatic georeferencing of images, usually called visual-based localization, relies on the registration of the image into a geolocalized reference. This reference can be of various types [Piasco et al. 2018] [Sattler et al. 2018], depending on the data available: for example it can be a set of geolocalized images [Song et al. 2016] or 3D structures such as sets of 3D points (LiDAR points or structure-from-motion points), as well as 3D models [Song et al. 2016] [Liu et al. 2017] [Sattler et al. 2017]. According to the multi-date contents considered here, this task of registration is challenging because it has to be done in complex conditions due to the photometric and geometric differences that may exist between the image to localize, acquired at a particular time period with a particular camera, and the reference, which usually models the environment at a more recent time period. At LaSTIG, we have developed several solutions for *automatic* visual-based localization, relying on the combination of a content-based image retrieval step followed by a pose estimation step, and exploiting different categories of references: one is based on sets of georeferenced images [Song et al. 2016] [Blettery, 2019], another on reconstructed 3D points from depths [Piasco et al. 2020]. We have also developed a web tool dedicated to the *semi-automatic* pose estimation and visualization of images from 3D building models [Harrach et al, 2019], but many others exist for this purpose, such as [Schaffland et al, 2020], [Blanc et al, 2018], [Maiwald et al, 2019].

The automatic and semi-automatic approaches prove to be complementary, because they have their own characteristics and do not respond similarly to the problem of visual-based geolocalization. For example, the automated methods developed do not require the knowledge of an initial pose but may not provide a very precise pose in all configurations, while the semi-automated tool is able to refine the pose precisely, given an initial pose close to the solution.

In this internship, several types of data are made available to perform the geolocalization, on a dedicated area as use case (Chalon-sur-Saône, location of the Musée Nicéphore Niépce): ancient photographs, recent geolocalized views of the city at the street level, 3D LiDAR points clouds and 3D building models.

The internship work is divided into 3 parts:

1. The study of state-of-the-art automatic and semi-automatic methods to geolocalize views using multimodal data as presented before. A focus on applications for multidate views would be a bonus.
2. Discovering and improving the already developed tool to have a baseline for street-level contents:

   – adapt it for a better handling of street-view images ;

   – modify it to exploit street-level 3D point clouds for the semi-automatic georeferencing process.

3. Choosing and implementing an existing automatic method and a semi-automatic method of geolocalization to visualize and compare their results against the aforementioned baseline in order to eventually integrate them in the pipeline once improved to better suit the needs of the specific street-view level photographs geolocalization problem.

Organization

Duration: 6 months, starting from march/april.

Workplace: IGN, LaSTIG lab, Paris area, Saint-Mandé (73 avenue de Paris, metro Saint-Mandé, Line 1), France.

IGN (French Mapping Agency) is a Public Administrative Institution part of the French Ministry for Ecology and Sustainable Development. IGN is the national reference operator for the mapping of the territory. The LaSTIG is one of the research laboratories of IGN, attached to University Gustave Eiffel. It gathers more than 100 researchers centered on geographical information, 35 of them focusing in image analysis, computer vision, AI, photogrammetry and remote sensing.

Salary: yes.

Skills

Bac+5 in computer science, applied math or geomatics (master or engineering school); good knowledge in image processing or photogrammetry/computer vision, as well as good skills in C/C++ programming or Python and web development.

Submitting your candidature

Before January 15th 2021, send by e-mail to the contacts **in a single PDF file**:

- CV
- motivation letter
- 2 recommendation letters, or persons to contact

- Transcript of grades from the last two years of study
- A list of courses followed and passed in the last two years

Contact

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