

PhD Thesis Proposal at CVC/IMAGINE (2012)

Registering textureless images on a 3D model and application to thermal images and building models

Context



It is easy, for the human eye, to recognize the shape of a building in a thermal image, which allows for a visual diagnosis. This is enough, e.g., for identifying a faulty window or roller shutter box because of poor insulation. But such a visual assessment is too coarse to precisely locate losses due to invisible objects such as thermal bridges, studs hidden under plaster, or leaks under floor heating. In such situations, the energy loss that appears on the image can be roughly located somewhere on a wall, floor or roof but without a particular mark. Moreover, scaling up to large buildings requires both global and detailed views that are difficult to coordinate with a large, unordered collection of thermal images at different scales.

Objective

The goal of the proposed thesis is to study the registration of images on a 3D model with little or no texture correlation. Registering in this case has to be based on other kinds of features, such as edges and contours. One application is to register thermal images of a building on an existing 3D building model. In fact, thermal images often consist of isotherm patches with a more or less uniform color, i.e., basically textureless. Such a registration not only allows moving virtually in a 3D thermal model for diagnosis, but also identifying and finely locating on the model elements that are normally invisible. It could also be used to refine simulations of building energy performance.



Profile and application

Required skills:

- MSc in computer vision — computational geometry is a plus,
- good background in mathematical methods for numerical optimization
- proficiency in C++.

To apply, please email:

- your CV,
- a transcript of your MSc grades/marks (even if incomplete),
- the report you wrote for your MSc thesis or for a previous internship,
- reference letters of previous supervisors or teachers,

- a brief description of your research interests highlighting the links between your education/training/experience and the thesis topic,

to

- Dr. Renaud Marlet (renaud.marlet@enpc.fr),
- Dr. Pascal Monasse (pascal.monasse@enpc.fr).

The IMAGINE Group

The [IMAGINE](#) Group is a joint project of the École des Ponts ParisTech ([ENPC](#)) and the French Scientific and Technical Centre for Building ([CSTB](#)), now part of the Center for Visual Computing (CVC), in association with the École Centrale de Paris ([ECP](#)), and it is part as well of the Computer Science lab ([LIGM](#)) of University Paris Est ([UPE](#)).

The domains of research of IMAGINE are computer vision, mesh processing, machine learning, statistics, optimization and constraint programming. In particular, IMAGINE has been working for several years on dense multi-view stereovision. One of the main focuses of the group has been on high precision 3D surface reconstruction from images, targeting large-scale data sets taken under uncontrolled conditions. Part of the group now also works on the interpretation and semantization of images and 3D models.

IMAGINE has got the best results worldwide on the Strecha et al. [reference benchmark](#), with the most complete and the most precise reconstructions. This expertise and software has been transferred in 2011 to the startup company [Acute3D](#), powering [Autodesk's 123D Catch](#) (formerly [project Photofly](#)), a web service to create 3D models from photographs. In November 2011, IMAGINE also won the [PRoVisG Mars 3D Challenge](#), consisting in image calibration and 3D model reconstruction tasks on Mars surface.