(SEC) SINGAPORE-ETH CENTRE 新加坡－ETH 研究中心

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Research Assistant/Postdoc: An Operable System for LoD3 Model Generation Using Multi-source Data and User-friendly Interactive Editing

Future Cities Laboratory, Singapore-ETH Centre

Project Description

Photo-realistic 3D city models that represent the physical and functional state of the city are necessary components of the nation's digital infrastructure. LoD 3 models contain building roof and façade geometry, as well as the functions of its different components (windows, doors, etc.). Generating accurate and standard 3D city models is a manually tedious, decisively rich and non-straightforward process, and the current practice of is LoD3 city modelling still a manually intensive process.

Given the high demand for city-scale model production in the Virtual Singapore program, we aim to develop an operable workflow that could produce LoD3 with the lightest possible manual involvement. A multi-data approach is used by integrating different sources of data including oblique imagery, aerial images, airborne/mobile LiDAR, and UAV images, to produce high quality LoD3 models that meet the CityGML standards. The workflow consists of three necessary work packages (WP) that develop techniques in 1) Geometry modelling; 2) semantic labeling and 3) interactive geometric editing. WP1 will develop novel image-based and LiDAR based roof topography and façade geometry modelling with automated and semi-automated methods. WP2 will apply data fusion techniques with the latest machine learning methods to perform land-cover classification and façade element attributation. WP2 will also develop a preliminary proof of concept in change detection and model updating. To ensure high fidelity of the resulting models, WP3 will develop novel visualization-driven editing procedures that efficiently correct errors of the models, and integrate the procedural modelling workflow to the 3D reconstruction of buildings with regular geometric patterns.

Our team consists of internationally recognized experts in photogrammetry, remote sensing, human-computer interaction and procedural modelling from ETH Zurich, The Ohio State University (OSU), University of Twente, FHNW University as well as industrial partners.

The major objective of this project is to work towards an operationally feasible approach to generate city-scale LoD3 models, and provide preliminary proof-of-concept on efficient model maintenance, to facilitate the broader mission of the Virtual Singapore program in developing Singapore as a more intelligent and smart city.

The project will be part of the Future Cities Laboratory (FCL) program, which undertakes cutting-edge research in disciplines ranging from material science, engineering and environmental technologies to geomatics, communications technology and architecture. The FCL aims to research and develop solutions and guidelines directed towards the sustainable development of buildings, districts and regions. In this project, ETH Zurich is collaborating closely with scientists

from the National University of Singapore (NUS) and the Nanyang Technological University (NTU) and many other Universities.

Key responsibilities

This is the position for the WP2 on Semantic Labeling. Your supervisor will be Prof. Rongjun Qin, and for any research related works you should directly report to Prof. Qin.

The successful applicant will study and understand the basic processing of various types of geospatial data, including airborne/Mobile LiDAR data, Mobile mapping images, airborne/oblique images, UAV images. He/she should be able to perform any geometric processing with these images, including geo-referencing of images, bundle adjustment, and multi-source data registration. He/she will develop algorithms that perform automatic scene labeling, including very high resolution 3D data classification using classical classifiers (e.g. SVM, Random Forest, MLC), as well as content labeling using trained, pre-trained deep convolutional neural networks. He/she may use publically available datasets, or may create own datasets for training, by considering the transferability of the pre-trained classifier. He/she will also develop pilot test program that performs automatic change detection between two sets of 3D data. In sum, tasks to be finished include:

1) Semi-automated/automated land-cover image classification for object recognition using very high resolution 3D data. Develop new joint feature representation to improve the land-cover classification accuracy to support LoD2 modelling.

2) Semi-automated/automated façade element identification. Use CNN and other hierarchical machine learning method to identify building elements, including doors, windows, balcony and so on.

3) Given the I/O protocol of CityGML models, a view-independent texture mapping will also be implemented to assign photorealistic textures to the LoD3 models.

4) Implement a top-view based change detection algorithm to form a test study.

5) The results will be in the form of an operable software system and at least two peer-reviewed journal papers.

Key Skills

The candidate should

- Have a Masters or PhD degree in Computer Vision, Geomatics, or with an equivalent relevant background in a major research University.
- Have strong C++ programing skills, proficient in packages such opencv, gdal and pcl, qt, opengl, etc.
- Have strong experience in Caffe or other related deep learning frameworks.
- Have strong experience and knowledge in 3D Computer vision and photogrammetry;
- Have solid basics in Mathematics and Statsitics.
- Have knowledge in using relevant softwares, such as LPS, photoscan, pix4D, geomagic, 3D Max, pointtools etc.
- Be a team player, open minded, with good communication skills
- Speak reasonably well English, and write English professionally

- Publications in high-quality peer-review journal, or renown computer vision conferences will be a plus.

Additional Information

- The position is primarily a full-time position of Research Assistant. The applicant holding a Ph.D. degree can request a post-doc title, subject to mutual agreement on working load.
- The candidate has the chance of short visits to Geospatial Data Analytics Laboratory (GDA), department of Civil, Environmental and Geodetic Engineering (CEGE) at the Ohio State University, Columbus.
- Candidate holding a terminal degree as Masters has the chance to be enrolled as as a Ph.D. student Ohio State University during the work or after the work, in GDA, department of CEGE, subject to mutual agreement and University policy.
- Well-performed candidate holding a Ph.D. degree has the chance to continue work as a post-doc or research scientist at the Ohio State University, GDA, department of CEGE.

Work location: 1 Create Way, CREATE Tower, Singapore 138602 (NUS University Town)

Duration: Full-time position, 2 years

Payment: Commensurate with ETH Zurich salaries

How to Apply: Applications with complete CV, degree certificates, academic transcript, a letter of motivation and intentions, and the names of two referees are requested as soon as possible. Please send the material via email to Prof. Dr. Rongjun Qin (qin.324@osu.edu) (*NOTE: Please send shared links if your files are larger than 10MB*). Preferred starting date is 1 August 2017.

Letter of motivation: Describe why you are good for this position.
Names of referees: Provide complete contact details, and let them know we might contact them if you are considered.

Email title format to Prof. Qin:
[Application for FCL position] --- Your Name ---- Bsc. University ---- MSc/Ph.D. University --- Major.

Once you've submitted your application, you will receive a confirmation acknowledging that your application package is received. The decision of hire will be made in May 2017.
Failing to accommondate the requested materials completely may result in rejection without consideration.

The Singapore-ETH-Centre is an equal opportunity and family-friendly employer. All candidates will be evaluated on their merits and qualifications, without regards to gender, race, age or religion.

About Singapore-ETH Centre

The Singapore-ETH Centre was established as a joint initiative between ETH Zurich – the Swiss Federal Institute of Technology in Zurich and Singapore's National Research Foundation (NRF), as part of the NRF's CREATE campus. The centre serves as an intellectual hub for research, scholarship, entrepreneurship, postgraduate and postdoctoral training.

The centre currently runs two research programmes, the Future Cities Laboratory (FCL), followed by Future Resilient Systems (FRS). It is home to a community of over 100 PhD, postdoctoral and Professorial researchers working on diverse themes related to sustainable cities and resilient infrastructure systems. In the course of their work, researchers actively collaborate with universities, research institutes, industry, and government agencies with the aim of offering practical solutions.