

## **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 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 labelling 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 attribution. 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**

The successful applicant will study and evaluate current methods for generating reality-based 3D city models with the purpose to identify shortcomings and promising solutions. He/she will, based on existing methodology and software like Image Matchers, CC-Modeler and others, design, develop and test new approaches, which will take us beyond the current state-of-the-art. Emphasis will be on the development of semi-automated procedures, that allow us, based on the results of a previous image matching process, to generate city models with a minimum of operator interference. Being a highly interdisciplinary team it will be important to keep close contact to the work of the other team members, who will look into the problems of generic and semantic modelling and of updating and maintaining of 3D city models (4D city modelling) and the design and development of appropriate user-interfaces.

Thus the main tasks include

- Analysing the current market of methodology and software with the goal to take over what may be useful for the project
- Designing a semi-automated procedure for city modelling from images (and to a lesser extent from LiDAR point clouds)
- Implementing and testing this approach, using the already available raw data over Singapore
- If the raw data is incomplete in some places use UAVs to fill the gaps
- Considering and integrating work and results which is performed in generic and semantic modeling

### **Key Skills**

The candidate should

- Have a Master or PhD degree in Geomatics, or with equivalent relevant background
- Have work experience in the field of Photogrammetry, especially in geo-referencing, image matching, feature extraction and object modeling
- Have knowledge in generic and semantic modeling and in point cloud processing
- Have good programming skills
- Be a team player, open minded, with good communication skills
- Speak reasonably well English

### **Your Profile**

You are interested in working in a large research project and you have the ability to perform innovative and high-end research that results in concrete tools and instruments applicable in real-world and industry-relevant scenarios. You are a highly motivated candidate with initiative and enjoy working in an interdisciplinary and multinational team. Required is a degree in geomatics or a related field. A strong background in applied mathematics, estimation theory and statistics is mandatory. Experiences in programming, image analysis, simulation, and/or visualisation are of advantage.

**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, a publication list, 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. Armin Gruen ([agruen@geod.baug.ethz.ch](mailto:agruen@geod.baug.ethz.ch)). Preferred starting date is 1 August 2017.

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.