

Workshop Report from the
ISPRS/COST-Workshop on quality, scale and analysis aspects of city models
Lund, Sweden, December 3-4, 2009

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The ISPRS/COST-workshop on quality, scale and analysis aspects of city models was held at the Geocenter of the Lund University from December 3-4, 2009.

The workshop was organized by the working groups II/2 (Multi-Scale Representation of Spatial Data), II/3 (Spatial Analysis and Data Mining), and II/4 (Uncertainty Modeling and Quality Control for Spatial Data) of Commission II (Theory and Concepts of Spatial Information Science) of the International Society for Photogrammetry and Remote Sensing (ISPRS), together with the Swedish Development Council for Geographic Information (ULI) and the EU COST Action TU0801 on "Semantic enrichment of 3D city models for sustainable urban development".

The scientific committee was represented by Lars Harrie (Lund University, Sweden), Monika Sester (University of Hanover, Germany), Liu Yaolin (Wuhan University, China), Alfred Stein (ITC, The Netherlands), Claudine Métral (University of Geneva, Switzerland), Gerhard Joos (NATO, The Netherlands), and Thomas H. Kolbe (Technical University Berlin, Germany).

The local organization was in the hands of Hanna Stigmar and Ara Toomanian from the GIS-Center of Lund University and Ludvig Emgård from C3 Technologies AB, Sweden. The workshop proceedings have been published on a workshop CD. Selected papers will be reviewed for publication in a special issue of ISPRS journal.

42 scientists from 12 different countries participated in the 2-days-workshop: The 20 presentations were subdivided into five sessions and were supplemented by a poster session. A time slot was reserved to form discussion groups.

As an introduction to the workshop, Thomas Kolbe, director of and Dean of Studies at the Institute of Geodesy and Geoinformation Science at the Berlin University of Technology, gave an inspiring keynote on the *assessment of the structural quality of virtual 3D city models*. In his talk, he analyzed different aspects of the data quality of 3D city models with respect to their semantic and geometric structure. He introduced the notion of „structural quality“ as a measure of the coherence between, and the richness of, semantic and geometric components of a model.

The second keynote was given by Kalle Åström, professor and head of division of Mathematics and Numerical Analysis at the Centre for Mathematical Sciences at Lund University. In his interesting talk on *Computer Vision and Cognitive Vision* he gave an overview on the history of the mathematics of computer vision, outlined classical problems such as the structure and motion problem of recovering the scene structure and the motion of a camera from a sequence of images, and outlined current problems in cognitive vision such as face understanding and automatic object detection.

The topic of the first session, *geometric reasoning*, was the logical deduction of geometric information from spatial facts by use of axiomatic calculi. Sandra Loch-Dehbi (Germany) presented a method to develop consistent and non-redundant models of building parts using automatic theorem proving on geometric constraint sets. Gwen Wilke (Austria) proposed a fuzzyfication of Euclidean incidence

geometry that can deal with geometric primitives that have extension in space. Youness Dehbi (Germany) showed how the formal grammar rules of 3D building models and their parts can be obtained by the machine-learning technique of Inductive Logic Programming.

The second session discussed aspects of *interpretation and enrichment* of city models. Hongchao Fan's (Germany) presentation addressed the visualization of change in spatio-temporal city models. He stressed that the interpretation of changes as events is dependent on the spatial and temporal resolution of the model and introduced a mathematical tool for event-detection. Frederik Tack (Belgium) proposed a method to extract urban surface models in a semi-automatic way from multi-scope Ikonos imagery. He showed that the proposed method provides an encouraging approach to cope with the high complexity of built-up areas in the context photogrammetric methods. Jonathan Quinn and Philip Smart (UK) described a novel and robust approach for the combination of 2D and 3D city models and the semantic enrichment of the output.

Scale is a long discussed topic in geographic information science, but the lack of, e.g., sufficient generalization functionality is still an issue. It was therefore very interesting to follow the ideas of scientists in the third session, *scale issues*. It started with the presentation of a conceptual process model for the generalization of hierarchical feature models: Richard Guercke (Germany) focused on the implementation of generalization as a generic service and proposed to overcome its strong application-dependency by a modularization of the process model. In the following talk, Monika Sester (Germany) gave an overview of the problems that arise from aggregating buildings in city models, when used in conjunction with terrain models. She presented a solution by considering height dependent constraints. Jochen Schiewe then discussed approaches from the field of visual analytics for change analysis processes with a special emphasis on considering uncertainty information.

Session four complemented the foregoing session on scale issues with a discussion of *technical issues*. Bo Mao (Sweden) introduced the CityTree framework which supports the generalization of 3D city models: With an implementation based on CityGML and X3D, CityTree defines a multiple representation data structure, which dramatically reduces the load time of 3D models and thereby allows dynamic zooming in real time. Mahdi Farnaghi (Iran) looked at different technologies, techniques and standards for 3D mobile GIS applications with the goal to find an integrated solution which reduces the workload of mobile devices and increases the efficiency of applications. As a result of performance tests, a client/server architecture was proposed that utilizes web services technologies and a tiling mechanism for large datasets. Ivan Novaković and Ivan Bacic-Deprato from the Croatian company Geofoto d.o.o. concluded the session with a very impressive report on the process of creating a virtual 3D model of the Croatian capital Zagreb, which was used to produce a 3x3 meters scale model of Zagreb by utilizing 3D printing technology.

The fifth and last session on *quality and applications* was started by Christoph Kinkeldey (Germany) who discussed an advanced uncertainty measure for classified remotely sensed scenes based on fuzzy set theory. By considering both, the uncertainties in the classification as well as in the reference data, the proposed measure accounts for the growing requirements on the correctness of models due to the increasing geometric and thematic accuracies of modern sensor systems. Florentina Farcas (Sweden) reported on the implementation of a GIS-software package for creating 3D road traffic noise maps and presented case a study for the Skåne region in the south of Sweden. The last presentation of the workshop was given by Ahmed Al Amouri (Germany) on the geometric and semantic quality assessment of historic images of the town of Baalbek, an urban heritage in eastern Lebanon. He showed that the 3D features derived from the historic imagery are sufficient to create a 3D city model of Baalbek that is based on CityGML in level of detail 1 and 2.

In addition to the oral presentations, several topics were presented in a poster-session. On the second day of the workshop, discussion groups were formed that focused on five different aspects of city models, and thereby allowed for a stimulating exchange of ideas. Results were reported subsequently to the whole audience.

In the course of the workshop a welcome reception and a workshop dinner was held as official events. The workshop dinner was located at a restaurant in the old town center of Lund and proceeded in a friendly mood, with a speech given by Jonas Andréasson from the Municipality of Lund.

The ISPRS/COST-workshop on quality, scale and analysis aspects of city models 2009 at Lund University was a fruitful workshop and definitely a success.