GUEST EDITORIAL PREFACE

Special Issue on Novel Developments in 3D GeoInformation Sciences

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An important aspect of the IJ3DIM's mission is to encourage developments in the field of 3D GeoInformation Sciences. 3D Geographical/Geospatial Models & Systems (GIS) have been an area of research for the last 20-30 years in different domains including Urban Management, City Modeling, Logistics, Environmental Management and Conservation, Emergency Response, Public Participation, Gaming, Infrastructure Management, Water Resources Management, Defense, Geology/Mining. Today, the overall interest in 3D GIS is growing as, 3D Geospatial Models (e.g. GML 3 / Google KML) are becoming well-known and mature, and City Modeling standards (such as City GML) are becoming global. A key dimension of the journal's scope is supporting the sharing of research related to 3D GIS and its applications in multiple domains.

A key annual event in the field of 3D GeoInformation Sciences is 3DGeoInfo Conference series. 3DGeoInfo series aims at bringing together international state-of-the-art research and facilitating the dialogue on emerging topics in the field of 3D GeoInformation. 8th 3DGeoInfo Conference was organised between 27-29 November2013 in Istanbul / Turkiye. Experts and academics from all over to world participated in 8th 3D GeoInfo 2013 to share their visions, and explore the opportunities of collaboration and cooperation. In 2013, the conference hosted 2 excellent keynote speeches from Mike Horhammer (Oracle) and Bart de Lathouwer (OGC Europe). During the conference, 1st meeting of the International Executive Board of 3DGeoInfo is conducted with the participation of Alias Abdul Rahman, Jantien Stoter(also representing Sisi Zlatanova), Jiyeong Lee, Philippe De Maeyer, Thomas Kolbe, Jacynthe Pouliot, Umit Isikdag, Claire Ellul, Christopher Gold, and Martin Breunig. The 3D GeoInfo 2013 conference was the 8th one in the series following the conference in Canada and before the conference in Dubai. There were 60+ papers presented by authors from all over the globe. This issue is based on (a selection of) extended versions of the papers which are presented during the conference.

In the first paper of the Issue, Uznir et al. presents "*3D Hilbert Space Filling Curves in*

3D City Modeling for Faster Spatial Queries". As indicated by authors the advantages of three dimensional (3D) city models can be seen in various applications including photogrammetry, urban and regional planning, computer games, etc. They expand the visualization and analysis capabilities of Geographic Information Systems on cities, and they can be developed using web standards. However, these 3D city models consume much more storage compared to two dimensional (2 D) spatial data. They involve extra geometrical and topological information together with semantic data. Without a proper spatial data clustering method and its corresponding spatial data access method, retrieving portions of and especially searching these 3D city models, will not be done optimally. Even though current developments are based on an open data model allotted by the Open Geospatial Consortium (OGC) called CityGML, its XML-based structure makes it challenging to cluster the 3D urban objects. In this research, we propose an opponent data constellation technique of space-filling curves (3D Hilbert curves) for 3D city model data representation. Unlike previous methods, that try to project 3D or n-dimensional data down to 2D or 3D using Principal Component Analysis (PCA) or Hilbert mappings, in this research, authors extended the Hilbert space-filling curve to one higher dimension for 3D city model data implementations. The query performance was tested for single object, nearest neighbor and range search queries using a CityGML dataset of 1,000 building blocks and the results are presented in this paper. The advantages of implementing space-filling curves in 3D city modeling will improve data retrieval time by means of optimized 3D adjacency, nearest neighbor information and 3D indexing. The Hilbert mapping, which maps a sub-interval of the [0,1] interval to the corresponding portion of the d-dimensional Hilbert's curve, preserves the Lebesgue measure and is Lipschitz continuous. Depending on the applications, several alternatives are possible in order to cluster spatial data together in the third dimension compared to its clustering in 2 D.

The second paper of the Issue, is by Brovelli et al., on "*Three dimensional Volunteered Geographic Information: a prototype of a social virtual globe*". The authors explained that the dawn of GeoWeb 2.0, the geographic extension of Web 2.0, has opened new possibilities in terms of online dissemination and sharing of geospatial contents, thus laying the foundations for a fruitful development of Volunteered Geographic Information (VGI) systems. The purpose of their study was to investigate the extension of VGI applications, which are quite mature in the traditional bi-dimensional framework, up to the third dimension by means of virtual globes. Inspired by the visionary idea of Digital Earth, virtual globes are changing the way people approach to geographic information on the Web. Unlike the 2D visualization typical of Geographic Information Systems (GIS), virtual globes offer multi-dimensional, fully-realistic content visualization which allows for a much richer user experience. The proposed system explained in this issue would couple a powerful 3D visualization with an increase of public participation thanks to a tool allowing data collecting from mobile devices (e.g. smartphones and tablets). The participative application, built using the open source NASA World Wind virtual globe, is focused on the cultural and tourism heritage of Como city, located in Northern Italy. Users can create and manage customized projects and populate a catalogue of cartographic layers which is available to the entire community. Together with historical maps and the current cartography of the city, the system is also able to manage geo-tagged data, which come from user field-surveys performed through mobile devices in order to report POIs (Points Of Interest). Users can also extend POIs information adding more textual and multimedia contexts (e.g. images, audios and videos) directly on the globe. All in all, the resulting application allows users to create and share contributions as it usually happens on social platforms, additionally providing a realistic 3D representation enhancing the expressive power of data.

In the third paper of the Issue, Kaden & Kolbe present their research on "*Simulation-Based Total Energy Demand Estimation of Buildings using Semantic 3D City Models*", as summarised by them, the present climate and environmental policy efforts require comprehensive planning regarding the modification of the energy supply and infrastructures in cities. The strategic planning of the different measures requires a holistic approach and the combination of extensive and complex information. Within this paper, current developments in the context of the project Energy Atlas Berlin are presented. The Energy Atlas Berlin is based on the semantic information model of CityGML and provides an integrative data backbone for the common spatio-semantic representation of the city structure including energy related information of different themes. The virtual 3D city model of Berlin (mainly LOD2 building models) is used as data basis and has been enriched by information of different stakeholders and disciplines. In order to ensure the energy supply, the knowledge about the energy demands of buildings during the planning and optimization of measures is of great strategic importance. Therefore, this paper focuses on the city-wide estimation of the energy demands of buildings including heating, electricity and warm water energy in the city of Berlin using available official geobase and statistical data integrated within the Energy Atlas Berlin. It is explained in detail how the spatial and semantic properties of the 3D building models are being used to estimate these energy demands on an individual building level for the entire city.

The final paper of the Issue is authored by Koehl et al..The paper focuses on digital reconstruction of an Historical Timber Frame Model for Diagnosis and Documentation before Building Restoration. Although the paper is closely related with AEC domain, acquisition of 3D geoinformation was required for the reconstruction of the model. The authors indicated the aim of the project was to define a four-level timber frame survey mode of a historical building: the so-called "Andlau's Seigniory", Alsace, France. This historical building was built in the late XVIth century and was in a stage of renovation in order to become a heritage interpretation centre. The used measurement methods combine Total Station measurements, Photogrammetry and 3D Terrestrial Laser scanner. Different modelling workflows were tested and compared according to the data acquisition method, but also according to the characteristics of the reconstructed model in terms of accuracy and level of detail. 3D geometric modelling of the entire structure was performed including modelling the degree of detail adapted to the needs. The described 3D timber framework exists now in different versions, from a theoretical and geometrical one up to a very detailed one, in which measurements and evaluation of deformation by time are potentially allowed. The virtually generated models involving archaeologists, architects, historians and specialists in historical crafts, are intended to be used during the four stages of the project: (i) knowledge of the current state of needs for diagnosis and understanding of former construction techniques; (ii) preparation and evaluation of restoration steps; (iii) knowledge and documentation concerning the archaeological object; (iv) transmission and dissemination of knowledge through the implementation of museum animations. Among the generated models we can also find a documentation of the site in the form of virtual tours created from panoramic photographs before and during the restoration works. Finally, the timber framework model was structured and integrated into a 3D GIS, where the association of descriptive and complementary digital documents was possible. Both offer tools leading to the diagnosis, the understanding of the structure, knowledge dissemination, documentation and the creation of educational activities. The integration of these measurements in a historical information system will lead to the creation of an interactive model and the creation of a digital visual display unit for consultation. It will be offered to any public to understand interactively the art of constructing a Renaissance structure, with detailed photos, descriptive texts and graphics. The 3D digital model of the framework will be

used directly in the interpretation path, within the space dedicated to "Seigniory" of Andlau. An interactive touch-screen will be installed. It will incorporate several levels of playgrounds (playful, evocative and teaching). In a virtual way, it will deal with the different stages of building a wooden framework and clarify the art of construction.

I would like to use this chance to thank to the contributors of this special issue, to the editorial review board of the journal and 3D GeoInfo Conference without which this Issue would not be possible. I would also like to conclude by encouraging all readers of the journal to submit their research results related BIM and 3D GeoInformation Sciences to our journal. We are very much looking forward to work with you towards publishing your work in IJ3DIM.

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Guest Editor
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