Towards the Next Generation of Full and Accurate 3D Building Models by Fusing Aerial and Terrestrial Imagery

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Abstract

Nowadays, the 3D city modeling is an emerging field of great interest to the broad community of computer science researchers. This paper concisely describes the content of recently defended thesis works dealing with various aspects of 3D city modeling (short abstract of Ph.D. Thesis). More specifically, the Ph.D. dissertation was entitled "Contributions to the 3D city modeling: 3D polyhedral building model reconstruction from aerial images and 3D facade modeling from terrestrial 3D point cloud and images" [1].

Keywords: **3D City Modeling, Building Roof Reconstruction, Urban Facade Modeling and Texturing, Mobile Mapping System, Calibrated Images, 3D Point Cloud.**

1. Problem Statement

The aim of this work is to develop research on 3D building modeling. In particular, the research in aerial-based 3D building reconstruction is a topic very developed since 1990. However, it is necessary to pursue the research since the current approaches for 3D massive building reconstruction (although efficient) still encounter problems in generalization, coherency and accuracy.

Besides, the recent developments of street acquisition systems such as Mobile Mapping Systems open new perspectives for improvements in building modeling in the sense that the terrestrial data (very dense and accurate) can be exploited with more performance (in comparison to the aerial investigation) to enrich the building models at facade level (e.g., geometry, texturing).

2. Major Contributions

Here, aerial and terrestrial based building modeling approaches are individually proposed. At aerial level, we describe a direct and featureless approach for simple polyhedral building reconstruction from a set of calibrated aerial images. At terrestrial level, several approaches that essentially describe a 3D urban facade modeling pipeline are proposed, namely, the street point cloud segmentation and classification, the geometric modeling of urban facade and the occlusion-free facade texturing.

Notably, these research works provide results for the computation of complete 3D building model (roof and facade) with an enhanced quality by fusing aerial and terrestrial data.

[1] This Ph.D. Dissertation as well as related works are available upon request or from http://recherche.ign.fr/labos/matis/~hammoudi

Context of the Thesis

This dissertation was submitted in 2011 for the PhD degree in Signal and Image Processing from the Université Paris-Est. The thesis work was performed at Institut Géographique National, IGN, Laboratoire MATIS, Saint-Mandé, France. The research works were directed by Dr. Nicolas Paparoditis and supervised by Prof. Fadi Dornaika (UPV/EHU, Spain) and Dr. Bahman Soheilian.

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Karim Hammoudi received the BSc degree in computer science from the University of Picardie Jules Verne (UPJV), France, in 2006. He received the BSc degree in mathematics in 2007. He got a merit scholarship and received the MS degree in computer science, mathematics and image processing from the University of Paris Descartes (UP5) in 2008. From October 2008 to October 2011, he was a PhD candidate at the MATIS Laboratory of the French National Mapping Agency (IGN) and at the Department of Mathematics and ICT of the University of Paris-Est (UPE). His PhD was carried out in collaboration with the Department of Computer Science and Artificial Intelligence of the University of Basque Country (UPV/EHU) and with the Basque Foundation for Science (Ikerbasque) both located in Spain. This PhD research dealt with the 3D building reconstruction by using aerial images and the 3D facade modeling by exploiting terrestrial laser and image street data acquired by a Mobile Mapping System. In parallel, he worked during this period as Assistant Lecturer in Computer Science at the Department of Mathematics and Computer Science of the University of Paris Descartes. Since November 2011, he is working as a StratAG Postdoctoral Research Fellow at the Department of Computer Science of the National University of Ireland Maynooth (NUIM). His current research lies in the areas of MMS data fusing, terrestrial modeling of structured environments as well as information enhancement of real-world scenes.