Sensors and Platforms for 3D Cadastres and 3D City Modeling: State of the Art and New Trends

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Key words: 3D City Modelling, 3D Cadastres, Sensors, Platforms, Mobile Mapping, Indoor Mapping, Oblique Imagery, Photogrammetry, Calibration, Multi-Sensor Systems, Integrated Sensor Systems

SUMMARY

Nowadays, 3D Cadastres and 3D City Modeling is done for a number of applications. The precision of the final 3D products affects the use of it. High Precision 3D data acquisition can certainly support many precision applications such as 3D registration of right, restrictions and responsibilities. The state of the Art sensors and platforms used for high precision 3D modeling are addressed in detail in this presentation, including integrated sensor systems for Aerial/Land/Marine high precision sensors, their data acquisition, processing and QA/QC protocols and procedures.

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1. INTRODUCTION

Nowadays, 3D Cadastres and 3D City Modeling is done for a number of applications. The precision of the final 3D products affects the use of it. High Precision 3D data acquisition can certainly support many precision applications such as 3D registration of right, restrictions and responsibilities. The state of the Art sensors and platforms used for high precision 3D modeling are addressed in detail in this presentation, including integrated sensor systems for Aerial/Land/Marine high precision sensors, their data acquisition, processing and QA/QC protocols and procedures.

After the Second World War, geospatial data acquisition and processing was consolidated and clearly categorized into land surveying for Topographic and Cadastre Applications, geodetic surveying for geodesy and Earth orientation, aerial surveys for 2D small/medium scale vector mapping, Land information Systems for GIS and Cadastre Applications. During the late 1980s and early 1990s, the academia focused its research and development (R&D) efforts on unblocking this blocked mindset. The Academic R&D resulted in a multi-disciplinary approach when addressing Geomatics sensors, systems, methods, mathematics, procedures, and platforms.

Schwarz et al, 1993, for example, addressed the pioneering academic efforts that changed the way photogrammetry and remote sensing data acquisition, processing and information extraction are done. These R&D efforts resulted in proving that a multi-sensor system containing imaging, positioning, and navigation sensors is possible to be integrated to operate in airborne, marine and land-borne environments. Multiple streams of data are possible to be collected, integrated, and harmonized in one single system. It took the industrial advanced firms a decade or two to build such systems in the form of complete products (c.f., Mostafa & Hutton, 2001, and Leberl, 2004, Ip et al, 2006, 2007).

Today, 3D data acquisition is a technology that leverages what the 1990s Academic R&D efforts produced. 3D data acquisition uses multi-sensor systems collecting data from various air, land, and marine platforms. The sensor assembly used in 3D modeling data acquisition contains navigation, positioning, laser, imaging, radar, telecommunication, and dead-reckoning sensors on one or more platforms collecting data simultaneously or consecutively. Then the data is integrated, manipulated and harmonized using software packages implying the mathematical concepts of positioning, navigation, signal processing, image processing, photogrammetry, and computer vision in order to capture the reality and produce a 3D virtual reality. Nowadays, a 3D City Model contains all the scene information including the indoor and outdoor shapes and dimensions. It simply allows for adding dimensions to all the visual information in any 3D scene.

Albeit the fact that all the state of the art measuring technologies allow for measuring some spatial dimension, every single measurement comes with an error associated with it. Controlling measurement errors is the craftsmanship of advanced scientists coming up with applied mathematics and scientific research to extract more accurate information from the various types of spatial data. The level of accuracies that are achievable nowadays are adequate to use 3D city models in numerous applications including ultimately the 3D Cadastre, where utmost precision is needed.

The measuring technologies, sensors, systems, and platforms in air and land, indoors or outdoors used for 3D city modeling are addressed in this presentation. Accuracy implications, different qualitative and quantitative factors are highlighted in some detail.

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BIOGRAPHICAL NOTES

Mohamed Mostafa, Navmatica ME's president, completed his PhD at the University Of Calgary, Canada, in 1999. He co-authored over 140 publications including: the Manual of Photogrammetry and the ASPRS DEM Manual. His research interests include multi-sensor systems, 3D City Modeing, mobile mapping, Direct Georeferencing of Airborne/Land/Marine Systems, GNSS, and GNSS/Inertial Integration, Calibration and Quality Control. He served as the VP of the ISPRS Comm I 2008-2012 and as the chair of the ASPRS DG committee 2001-2010 where he co-organized over 30 conferences in Canada and the USA. Futher, he is currently an Adjusnct Professor at the American University in Dubai

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