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Automated 3D Modelling of LoD2 Buildings Based on Data of Aerial Laser Scanning

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Abstract:

Three-dimensional (3D) modelling of towns and buildings is currently a key tool in the field of modern geographic information systems (GIS), urban planning, architecture and crisis management. The transition from traditional 2D maps to 3D models allows capturing vertical information, which is essential for comprehensive analyses of the urban environment. 3D models find application in assessing the solar potential of roofs, analyzing noise pollution, modeling flood risks and in digital twin concepts of towns. The CityGML 2.0 standard, defined by the OGC consortium, categorizes models into levels of detail (LoD). LoD2 faithfully captures the geometry of roofs. The automation of creation of LoD2 from airborne laser scanning (ALS) point clouds represents a major challenge in the efficient processing of large territorial units.

The aim of this paper is to present the process of automated creation of 3D building models at the LoD2 level of detail using data of ALS. The generation of 3D building models at the LOD2 level was carried out in three test areas of the town of Bratislava (Slovakia). The methodological procedure is divided into several phases: from preprocessing and classification of the point cloud, through extraction of footprints and height attributes (ridge and eaves height), to the procedural modeling itself. ArcGIS Pro and Esri CityEngine were used. Using the CGA (Computer Generated Architecture) scripting language, rules were defined for automatic generation of roof shapes and elements based on pre-calculated attributes.

The study evaluated the accuracy of the generated 3D building models. The accuracy of the building footprints is verified by comparison with vector data from the cadastre of real estate. Vertical accuracy is assessed separately for the eaves height and the ridge height. These parameters are validated by calculating the root mean square error (RMSE) and standard deviation against manually digitized points.

The results show that although automation significantly speeds up the process of creation of large-scale urban models, the quality of the output remains dependent on the precise classification of input data of ALS and the correct interpretation of the segmented roof planes. The implementation of procedural rules in CityEngine allows to reduce the processing time of larger urban areas. The tested procedure can be applied to modelling 3D buildings for other towns in Slovakia.

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