Efficient Generation of 3D Building Models from Airborne Laser Scanning Point Clouds and Aerial Photos

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Geometrically and topologically correct 3D building models are required to satisfy the increasing demand in, for instance 3D cadaster, virtual reality, emergency response, robot navigation, and urban planning. Airborne Laser Scanning (ALS) is still the preferred data acquisition system for automated building modeling. Although ALS point clouds are useful for a highly automated processing workflow with high vertical accuracy, their sparse point distribution reduces the planimetric accuracy of model boundaries significantly. In comparison to the ground sampling of digital aerial images to the centimeter level, the planimetric accuracy of building models derived from point clouds is severely limited. Since point clouds and images have rather complementary properties, the integration of these two data sources leads to building models of high vertical accuracy, as well as planimetrical accuracy. In this study, a new framework for the automatic reconstruction of building models by integrating ALS point clouds and digital aerial image data is proposed. Topology preserving 3D roof models is first derived from point clouds. These models are subsequently refined to increase the planimentric accuracy with image data. In addition, some of the topological inaccuracies of the initial roof models are rectified. A novel approach employing a cycle graph analysis is introduced to generate the topology preserving roof models from point clouds. Initial and refined roof models derived from the developed schemes are analyzed with the ISPRS benchmark test data. The results of the three test scenes showed that both methods are acceptable, and can be used with more complex urban scenes. While proving the robustness of the cycle graph approach by the initial results, the refined models demonstrate that image integration improves the planimentric accuracy significantly, with almost 100% topological and geometrical correctness.

Keywords: Airborne laser scanning, cycle graphs, reconstruction