ABSTRACT

Fu, Chiung-Shiuan. Ph.D., Purdue University, May, 2010. 3D Building Model Reconstruction from Point Primitives. Major Professor: Jie Shan.

Accurate and complete 3D building model generation has experienced a rapid increase in interest and application. Building data can be acquired from a wide range of sources; nevertheless, there is a continuing need for simplification of the input data. The goal of this work is to construct high quality building models from roof points. The generation of the topological relationship among primitive points is automated by computational geometry algorithms. The underlying thought of roof surface reconstruction is to determine its skeleton, a straight line structure comprising boundary edges and roof ridges. To find boundary edges, two boundary cycle searching algorithms are developed, one for orthogonal boundaries and the other for general boundaries with less angle constraint. An algorithm is specially designed to find fundamental cycles for orthogonal boundaries. Then, the finding-all-cycles algorithm is performed and the most appropriate boundary cycle is selected based on the properties of the orthogonal boundary. To find the general boundaries, a voting system is applied to select a set of edges which grows to a set of paths. A set of cycles are then generated from the paths. The final boundary cycles are selected based on the geometric assumptions. Roof ridges usually follow the trend of the boundary shape in terms of parallelism and symmetrization. Edges parallel to the boundary or partition the boundary evenly and symmetrically are considered as roof ridges. The remaining skeleton edges are determined by rendering the existing edges and points in a roof domain through constrained Delaunay triangulation. The polygonal surface of the building model is reconstructed based on the skeleton and is represented by a set of polygons. Least square adjustment and geometric conditions are applied to refine

the reconstruction models. The final geometric and topological information of a 3D building object is established by the boundary representation technique. The performance of the proposed approach is evaluated by buildings of three data sets. The overall success rate is above 94% which proves the feasibility of the approach.