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Automated Transformation of 3D Point Cloud to BIM Model: Leveraging Algorithmic Modeling for Efficient Reconstruction

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Abstract : The digital era has revolutionized architectural practices, with building information modeling (BIM) emerging as a pivotal tool for architects, engineers, and construction professionals. However, the transition from traditional methods to BIM-centric approaches poses significant challenges, particularly in the context of existing structures. This research introduces a technical approach to bridge this gap through the development of algorithms that facilitate the automated transformation of 3D point cloud data into detailed BIM models. The core of this research lies in the application of algorithmic modeling and computational design methods to interpret and reconstruct point cloud data -a collection of data points in space, typically produced by 3D scanners- into comprehensive BIM models. This process involves complex stages of data cleaning, feature extraction, and geometric reconstruction, which are traditionally time-consuming and prone to human error. By automating these stages, our approach significantly enhances the efficiency and accuracy of creating BIM models for existing buildings. The proposed algorithms are designed to identify key architectural elements within point clouds, such as walls, windows, doors, and other structural components, and to translate these elements into their corresponding BIM representations. This includes the integration of parametric modeling techniques to ensure that the generated BIM models are not only geometrically accurate but also embedded with essential architectural and structural information. Our methodology has been tested on several real-world case studies, demonstrating its capability to handle diverse architectural styles and complexities. The results showcase a substantial reduction in time and resources required for BIM model generation while maintaining high levels of accuracy and detail. This research contributes significantly to the field of architectural technology by providing a scalable and efficient solution for the integration of existing structures into the BIM framework. It paves the way for more seamless and integrated workflows in renovation and heritage conservation projects, where the accuracy of existing conditions plays a critical role. The implications of this study extend beyond architectural practices, offering potential benefits in urban planning, facility management, and historic preservation.

Keywords : BIM, 3D point cloud, algorithmic modeling, computational design, architectural reconstruction
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