Hybrid Machine Learning Inspired Digital Built Environment Generation for Energy Modeling

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Abstract

Developing accurate neighborhood topography is crucial for precise energy modeling in built environments. The research work proposes a novel hybrid method that integrates diverse data sources, including light detection and ranging (LiDAR), digital elevation model (DEM), digital terrain model (DTM), normalized digital surface model (nDSM), digital surface model (DSM), and drone data, to create 3D models of built structures. The primary objective is to refine the methodology for complex roof shapes and openings by combining GIS data with drone imagery using machine learning algorithms. This integrated approach aims to develop detailed 3D models of neighborhoods for energy modeling, facilitating a comprehensive assessment for achieving net-zero energy goals. Further, the automated geometric data processing workflow is developed in this research that will automate the process of converting integrated data into a Rhino-Grasshopper environment for energy modeling. This approach enables the rapid creation of energy models by significant savings in time and effort. By leveraging this combination of data sources, researchers and urban planners can analyze and optimize energy consumption, identify renewable energy potential (e.g., for solar neighborhood design), and enhance overall neighborhood sustainability. This comprehensive approach to constructing building geometry and topography promises more precise and sustainable community energy modeling, which is essential for developing smart sustainable net-zero communities.

Keywords: Neighborhood energy modeling, energy efficiency, DEM, DTM, DSM, nDSM, drone imagery and machine learning.

Themes for the research: Clean Tech Innovation - Smart communities, Smart cities, AI, big data, net-zero planning.

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