SingleRecon: Reconstructing Building 3D models of LoD1 from A Single Off-Nadir Remote Sensing Image

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Abstract

3D building models are one of the most intuitive and widely used forms for understanding urban buildings. Generating 3D building models based on a single off-nadir satellite image is an economical and rapid method, particularly valuable in large-scale 3D reconstruction scenarios with limited time. In this paper, we propose a novel pipeline for automatically reconstructing LoD1 3D building models based on a single off-nadir satellite remote sensing image. Our pipeline is built upon a multi-task neural network called ONBuildingNet (Off-Nadir Building Reconstruction Network), which extracts building roof polygons and offsets from the image. Using this information, the pipeline computes the building footprint polygons and heights, constructs LoD1 building models, and then extract textures from the off-nadir image. ONBuildingNet introduces our proposed cross-field auxiliary task and multi-scale mask head to extract building roof polygons with accurate shapes. We have demonstrated through extensive experiments that our pipeline can automatically and rapidly construct LoD1 3D urban building models. Additionally, our proposed ONBuildingNet outperforms current state-of-the-art methods in extracting more shape accurate building roof polygons, thereby enhancing the accuracy of the final 3D models produced by our pipeline. Please visit our project page at https://shaoruizhe.github.io/building-stand-up.github.io/ to gain a more intuitive understanding of our method.

Keywords: 3D reconstruction, LoD1 3D building model, off-nadir satellite image, building roof polygon extraction