Building Footprint Regularization : From Vectorization to Deep Learning

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Abstract

Geographic information systems (GIS) and cartographic applications typically require building footprints as precise vector polygons, rather than raster masks [1#:~:text=While%20most%20state,and%20polygonal%20angle%20difference%20loss]. Building footprint regularization refers to the process of refining raw building outlines (e.g. from remotely sensed imagery or LiDAR) into clean polygon shapes that conform to expected geometric constraints (such as orthogonal corners or aligned edges). The goal is to eliminate irregular artifacts (noisy jags, misalignments) while preserving the true shape, so that the footprints are cartographically suitable for maps In many cases, regularization assumes buildings are rectilinear structures with predominantly 90° corners : an assumption that, while not universally true, holds for most residential and industrial buildings. This review traces the evolution of footprint regularization methods from early vectorization algorithms in the 1990s through modern deep learning approaches in the 2020s.

We focus on 2D footprint outline techniques (planimetric building outlines) and exclude full 3D building reconstruction or roof modeling. Key developments and representative methods are discussed for each era, highlighting their algorithms, use cases, strengths, and limitations. We then compare traditional versus deep learning-based methods in terms of performance, flexibility, accuracy, and integration into GIS workflows. The review draws on peer-reviewed research and real-world implementations (including open- source tools and commercial pipelines) to provide a comprehensive perspective for remote sensing and GIS professionals.

Geometric and Heuristic Methods (1990s - 2000s)

References

1. **PolyWorld: Polygonal Building Extraction With Graph Neural Networks in Satellite Images**
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