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FUSION OF LIDAR DATA AND MULTISPECTRAL IMAGERY FOR EFFECTIVE BUILDING DETECTION BASED ON GRAPH AND CONNECTED COMPONENT ANALYSIS

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Abstract. Building detection in complex scenes is a non-trivial exercise due to building shape variability, irregular terrain, shadows, and occlusion by highly dense vegetation. In this research, we present a graph based algorithm, which combines multispectral imagery and airborne LiDAR information to completely delineate the building boundaries in urban and densely vegetated area. In the first phase, LiDAR data is divided into two groups: ground and non-ground data, using ground height from a bare-earth DEM. A mask, known as the primary building mask, is generated from the non-ground LiDAR points where the black region represents the elevated area (buildings and trees), while the white region describes the ground (earth). The second phase begins with the process of Connected Component Analysis (CCA) where the number of objects present in the test scene are identified followed by initial boundary detection and labelling. Additionally, a graph from the connected components is generated, where each black pixel corresponds to a node. An edge of a unit distance is defined between a black pixel and a neighbouring black pixel, if any. An edge does not exist from a black pixel to a neighbouring white pixel, if any. This phenomenon produces a disconnected components graph, where each component represents a prospective building or a dense vegetation (a contiguous block of black pixels from the primary mask). In the third phase, a clustering process clusters the segmented lines, extracted from multispectral imagery, around the graph components, if possible. In the fourth step, NDVI, image entropy, and LiDAR data are utilised to discriminate between vegetation, buildings, and isolated building's occluded parts. Finally, the initially extracted building boundary is extended pixel-wise using NDVI, entropy, and LiDAR data to completely delineate the building and to maximise the boundary reach towards building edges. The proposed technique is evaluated using two Australian data sets: Aitkenvale and Hervey Bay, for object-based and pixel-based completeness, correctness, and quality. The proposed technique detects buildings larger than 50 m^2 and 10 m^2 in the Aitkenvale site with 100% and 91% accuracy, respectively, while in the Hervey Bay site it performs better with 100% accuracy for buildings larger than 10 m^2 in area.

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