DEEP LEARNING AND OBIA APPROACHES FOR EXTRACTING BUILDING FOOTPRINT BASED ON UAV IMAGES

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The initial step for creating an LOD-2 3D building model is to extract the building footprint, LOD-0. There are several data types suitable for extracting the building footprint, such as aerial imagery, high-resolution satellite imagery, airborne lidar, and others. In this study, the UAV aerial images taken at Universitas Gadjah Mada in Indonesia were utilized for building footprint extraction through photogrammetric Structure from Motion (SfM) and Multiview stereo (MvS) techniques to generate dense clouds. These dense clouds were then categorized into ground and non-ground elements to create a Digital Terrain Model (DTM) and a Digital Surface Model (DSM). Additionally, true-orthoimage was generated using DSM. Object-based image analysis (OBIA) and deep learning methods were employed in this study. To obtain the building footprint using OBIA, a combination of true-orthoimage and Object Height Model (OHM), i.e. DSM-DTM, was utilized. Various rulesets for classification were tested, including using mean values of green ratio to minimize vegetation objects. To perform deep learning processing, a U-Net Architecture with a Convolutional Neural Network (CNN) was selected. In order to find the most effective result of deep learning, we conducted three training models using different rotation angles: 0 degrees, 45 degrees, and 90 degrees. The building footprints were labeled from diverse regions and assigned to the building class for detection purpose. Resnet-34 was chosen as the underlying architecture for the model. We discovered that deep learning results sometimes include building structures with holes. Consequently, we undertook the task of eliminating the polygons representing building structures and also removed polygons with an area smaller than 30 square meters. Evaluating the building footprint extraction results from both methods showed an Intersection over Union (IoU) score over 80 percent, with precision, recall, and F1 scores exceeding 90 percent for both methods. The deep learning approach yielded the most favorable result when the rotation angle was set as 0 degrees, which has obtainedan IoU score of 86.58 percent. On the other hand, the OBIA-based building footprint extraction method obtained an IoU score of 86.18 percent.

Keywords: Building Footprint, OBIA, Deep Learning, U-Net