fine-tuning of deep learning-based edge detection models for building and road extraction in Very-high-resolution images

Jinmin Lee1, Changhui Lee2, Hanul Kim3, Hongtak Lee4, Youkyung Han\*5

1Master Student, Department of Civil Engineering, Seoul National University of Science and Technology

232 Gongneung-ro, Nowon-gu, Seoul, 01811, South Korea

Email: j1nm2\_0212@seoultech.ac.kr

2Ph.D Student, Department of Civil Engineering, Seoul National University of Science and Technology

232 Gongneung-ro, Nowon-gu, Seoul, 01811, South Korea

Email: ckdgml914@seoultech.ac.kr

3Assistant Professor, Department of Applied Artificial Intelligence, Seoul National University of Science and Technology

232 Gongneung-ro, Nowon-gu, Seoul, 01811, South Korea

Email: hukim@seoultech.ac.kr

4Researcher, Satellite Operation and Application Center, Korea Aerospace Research Institute

169-84 Gwahak-ro, Yuseong-gu, Daejeon, 34133, South Korea

Email: leeht@kari.re.kr

\*5Associate Professor, Department of Civil Engineering, Seoul National University of Science and Technology,

232 Gongneung-ro, Nowon-gu, Seoul, 01811, South Korea

Email: han602@seoultech.ac.kr

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**ABSTRACT:** Edge information of very-high-resolution (VHR) images acquired from satellites, aircrafts, or drones can provide the shape and boundary of objects and terrains. For this reason, the edge information has been used in various fields such as natural disaster management and environmental monitoring. Due to deep learning-based edge detection methods do not need for humans to set parameters and provide accurate and connected edge detection results, various deep learning-based edge detection methods have recently been developed and their pretrained models are provided. However, most of the pretrained deep models are built using natural image datasets, which have different properties from the VHR images. Accordingly, important objects such as buildings and roads, which occupy the largest proportion in downtown areas, are poorly detected by the pretrained models. In this study, we aim to build deep models suitable for detecting the edges of buildings and roads by performing the fine-tuning process of pretrained deep models using VHR satellite images. The training dataset is generated 10 times augmenting the open-source dataset consisting of VHR images and label data about buildings and roads provided by AI-hub. Subsequently, we conduct the fine-tuning process for HED (holistically-nested edge detection) and PiDiNet (pixel difference network). HED has a hierarchical structure to use both global and local features, and PiDiNet applies pixel difference convolution for fast and accurate operation. The learning rate is adjusted from 5e-03 to 5e-04 to maintain the original weights based on natural images, and the remaining hyperparameters are set as the same conditions of pretrained manner. Then, the edge information is extracted by converting edge probability maps into edge binary images applying the threshold value. To evaluate the edge detection performance, a test dataset was constructed with building and road layers of a digital map and satellite image of Daejeon, South Korea, and a visual comparison of reference data and output was performed. In addition, based on the test dataset, kappa coefficient, F1-score, and the IoU (intersection over union) for the edge were calculated for numerical comparison. As a result, visually remarkable edges of buildings and roads were extracted, and high index values were obtained from the models after fine-tuning. Through this research, we confirmed that edges of the buildings and roads can be detected more effectively by fine-tuning the models using remote sensing training dataset.

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