An Automatic Landslide Detection Technique Using Deep Convolutional Neural Networks and Orthophoto

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Deep learning machine algorithms learn representations of data with multiple levels of abstraction; have recently gained significant attentions in machine learning and geoscience communities. Yet their strengths have not been broadly explored in natural hazard mapping and modeling. In particular, deep convolutional neural networks (DCNN) is a category of deep learning that is suitable for object detection and can achieve reliable accuracy. This paper presents an automatic landslide detection in tropical regions using DCNN trained on a manually prepared dataset from a grayscale orthophoto acquired over Cameron Highlands, Malaysia. The proposed model has a simple architecture including an input layer with (28 ×28) nodes, two convolution and two pooling layers, followed by two fully connected layers. The probabilities of the classes were calculated with a Softmax layer. To apply the DCNN, a number of proposals (i.e. probable targets) were first selected from the input image using a baseline technique called sliding window method. Then, low level features were extracted from each selected proposal and sent out to the deep network. After that, high-level features were learned by the deep network and used to classify the proposals and detect landslide objects in the input image. Experimental results show that the proposed landslide detection based on DCNN can achieve an overall accuracy of 78%. In addition, a comparative study with one-layer neural network (NN), support vector machine (SVM), and logistic regression (LR), showed that the proposed model outperforms NN (57%) and LR (77%) and achieves accuracy comparable to that achieved by SVM (78%) method. Overall, this study successfully applied deep learning algorithm in landslide mapping and modelling as well as to creating standard large-scale landslide inventory datasets that can help advancing this field by further research.

Keywords: landslide detection, LiDAR, Deep Convolutional Neural Networks , Orthophoto, GIS

