

Rockfall source identification using a hybrid Gaussian mixture-ensemble machinelearning model and LiDAR data

ABSTRACT

The availability of high-resolution laser scanning data and advanced machine learning algorithms has enabled an accurate potential rockfall source identification. However, the presence of other mass movements, such as landslides within the same region of interest, poses additional challenges to this task. Thus, this research presents a method based on an integration of Gaussian mixture model (GMM) and ensemble artificial neural network (bagging ANN [BANN]) for automatic detection of potential rockfall sources at Kinta Valley area, Malaysia. The GMM was utilised to determine slope angle thresholds of various geomorphological units. Different algorithms (ANN, support vector machine [SVM] and k nearest neighbour [kNN]) were individually tested with various ensemble models (bagging, voting and boosting). Grid search method was adopted to optimise the hyperparameters of the investigated base models. The proposed model achieves excellent results with success and prediction accuracies at 95% and 94%, respectively. In addition, this technique has achieved excellent accuracies (ROC = 95%) over other methods used. Moreover, the proposed model has achieved the optimal prediction accuracies (92%) on the basis of testing data, thereby indicating that the model can be generalised and replicated in different regions, and the proposed method can be applied to various landslide studies.

Keyword: Rockfall source identification; Gaussian mixture model; ensemble machine learning; GIS; LiDAR