Landslide Prediction Study in Malaysia

Swee Peng Koay (1), Habibah Lateh (2), Satoshi Murakami (3), Tomofumi Koyama (4), Naoki Sakai (5), and Suhaimi Jamaludin (6)

(1) School of Computer Sciences, Universiti Sains Malaysia, Penang, Malaysia (spkoay@cs.usm.my), (2) School of Distance Education, Universiti Sains Malaysia, Penang, Malaysia (habibah@usm.my), (3) Department of Urban and Civil Engineering, Ibaraki University, Ibaraki, Japan (murakami@mx.ibaraki.ac.jp) , (4) Department of Urban Management, Kyoto University, Kyoto, Japan (koyama.tomofumi.6s@kyoto-u.ac.jp), (5) Storm, Flood and Landslide Research Unit, National Research Institute for Earth Science and Disaster Prevention, Ibaraki, Japan (sakai@bosai.go.jp) , (6) Slope Engineering Department, Public Works Department Malaysia, Kuala Lumpur, Malaysia (suhaimij@jkr.gov.my)

In Malaysia, landslides are occurring more often than before. The Malaysian Government allocates millions of Malaysian Ringgit for slope monitoring and slope failure measurement in the budget every year. In rural areas, local authorities also play a major role in monitoring the slope to prevent casualty.

However, there are thousands of slopes which are classified as dangerous slopes. Implementing site monitoring system in these slopes, with extensometers, soil moisture probes, inclinometers and water gauges, to monitor the movement of the soil in the slopes and predict the occurrence of slopes failure, are too costly and almost impossible.

Here, two snake curve methods, Accumulated Rainfall vs. Rainfall Intensity Method and Working Rainfall vs. Rainfall Intensity Method, for the slope failure prediction are proposed.

In Accumulated Rainfall vs. Rainfall Intensity Method, Accumulated Rainfall is defined as $R_N = \sum_{t=1}^{N} r_t$, where R_N is the accumulated rain from t = 1 to N , and will be reset to 0 if the rain stop period is longer than the period of water table drawdown to pre-rain level. Rainfall Intensity is hourly rainfall.

The definition of Working Rainfall, in Working Rainfall vs. Rainfall Intensity Method, is $R_w = r_t + \sum_{n=1}^{N} \alpha_{t-n} \cdot r_{t-n}$, where r_t is the volume of rainfall in tth. hour, r_{t-n} is the volume of rainfall in $(t - -n)$th. hour and $r0 = 0$, a_{t-n} is the reduction factor defined as follows, $\alpha_{t-n} = 0.5^{n/T}$, where T is a half-life period (in hours), and N < t . If a_{t-n} <0.004 then, $a_{t-n} \bullet r_{t-n}$ can be ignored.

The critical line, in the snake curve graph, which determines if the slope is in a risk state, should be generated by the recorded landslides data. However, a complete history of landslides data is difficult to be obtained. The critical line is drawn by referring to the simulation result of factor of slope stability F, with the slope parameters and rainfall data. If the curves cross over the critical line, the probability of slope failure is considered high.

In this study, the proposed methods managed to predict the occurrence of landslides. In future, further study on the enhancement of the methods may assist the government authorities to judge the movement of the slopes before disseminating data and information for early warning system.