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Neuro-fuzzy-based landslide susceptibility analysis – an example from Central Western Taiwan

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Back-propagation neural network (BPNN) was used to evaluate landslide susceptibility by some researchers previously. It is feasible for classification purpose, but it is difficult to output a serial of continuous values or several classes for susceptibility mapping. The purpose of this study is to introduce the fuzzy logic concept into the BPNN to develop a landslide susceptibility analysis technique and apply this new technique to landslide susceptibility mapping at a specific study area called Kuohsing in Central Western Taiwan. Earthquake-induced landslides from the 1999 Chi-Chi Earthquake were selected for study.

Data were partitioned into two parts randomly, a part of the samples were used as training data and the others were used for validating the result. Like the BPNN, training data consist of landslide group and non-landslide group, but the difference between our system and the BPNN is that the target output is pre-defined landslide membership and non-landslide membership, instead of binary (0 or 1). This is a simple fuzzy neural network (FNN) which can be carried out in Matlab.

In the application of FNN, the output at each studying point is also a fuzzy membership. A fuzzy membership is then defuzzy?ed to a single value to indicate the landslide susceptibility index (LSI). Our example shows that the LSI values present a continuous value ranging from 0 to 1, and also, landslide ratio increases with increasing LSI value. This trained model was then applied to the whole study area, and got LSI value at each grid point, and at last the landslide susceptibility of the area were mapped. Validation of this susceptibility map was performed by using the second part of data. The prediction rate curves are very good, especially at the hilly terrain. This result indicates that the FNN is an encouraging approach to the landslide hazard assessment and mapping.