Flood forecasting using coupled long short-term memory (LSTM) and generative adversarial networks (GAN) with hybrid activation function – A Case Study for Hangang River, South Korea

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(a) Purpose of study or research hypothesis

Flood forecasting conducted by numerical models has become less qualified before due to climate change. To improve the accuracy of forecasting flood, the novel approach with the coupled Long Short-Term Memory (LSTM) and Generative Adversarial Networks (GAN), was proposed in this study to alleviate the under-forecasting problems of existing neural network models.

(b) Key issue(s) or problem(s) addressed

The use of data driven models including neural network models was increased to forecast the flood, since the big data processing technology has been developed and simulation time became shorter. However, the neural network models like LSTM and RNN for forecasting time series data have problems of under-forecasting the values due to various causes such as misuse of activation function, lack of data set, quality control of data and so on.

(c) Methodology or approach used

The GAN model composed of generator and discriminator was used to generate the extreme scenarios by training the input data set and coupled with the LSTM model. Tensorflow was used as a tool for developing the data driven model. And it was applied to Hangang River, Korea. The target values were water surface elevations for various leading time intervals, one of the factors to determine the occurrence of flood. The parameters of neural network model such as number of hidden layers, learning rate, sequence length and epochs were derived by performing the sensitivity analysis. The input data were normalized to improve the accuracy of forecasting and the hybrid activation function, combination of ReLU and hyperbolic tangent function, was proposed in this study

(d) Results or conclusions derived from the project

The Root Mean Square Error (RMSE), Nash-Sutcliffe efficiency (NSE), and Peak Error (PE) were checked for high water surface elevation above the designated water surface elevation. And, each optimal coefficient values were suggested for leading time intervals in terms of occurrence time and peak value. Finally, flood risk assessment was performed using the results from this model using the metrices for classification evaluation. It was considered that the data driven model proposed in this study would be suitable for forecasting the higher floods.

(e) Implications of the project relevant to congress themes

We can expect that it can be used to establish the countermeasures for the flood risk if the accuracy of model with hybrid activation function will be improved. It can be accomplished by considering high quality of data in the future.

Keywords : Flood forecasting, Long Short-Term Memory, Generative adversarial networks, Hybrid Activation Function