CHAPTER 2

LITERATURE SURVEY

[1] Prediction Analysis of Floods Using Machine Learning Algorithms (NARX & SVM)

The changing patterns and behaviors of river water levels that may lead to flooding are an interesting and practical research area. They are configured to mitigate economic and societal implications brought about by floods. Non-linear (NARX) and Support Vector Machine (SVM) are machine learning algorithms suitable for predicting changes in levels of river water, thus detection of flooding possibilities. The two algorithms employ similar hydrological and flood resource variables such as precipitation amount, river inflow, peak gust, seasonal flow, flood frequency, and other relevant flood prediction variables. In the process of predicting floods, the water level is the most important hydrological research aspect. Prediction using machine-learning algorithms is effective due to its ability to utilize data from various sources and classify and regress it into flood and non-flood classes. This paper gives insight into mechanism of the two algorithms in perspective of flood estimation.

[2] Streamflow Prediction Using Deep Learning Neural Network

The most important motivation for streamflow forecasts is flood prediction and longtime continuous prediction in hydrological research. As for many traditional statistical models, forecasting flood peak discharge is nearly impossible. They can only get acceptable results in normal year. On the other hand, the numerical methods including physics mechanisms and rainfall-atmospherics could provide a better performance when floods coming, but the minima prediction period of them is about one month ahead, which is too short to be used in hydrological application. In this study, a deep neural network was employed to predict the streamflow of the Yangtze River. This method combined the Empirical Mode Decomposition (EMD) algorithm and Encoder Decoder Long Short-Term Memory (En-De-LSTM) architecture. Owing to the hydrological series prediction problem usually contains several different frequency components, which will affect the precision of the longtime prediction. The EMD technique could read and decomposes the original data into several different frequency components. It will help the model to make longtime predictions more efficiently.

[3] Forecasting Daily Precipitation Using Hybrid Model of Wavelet-Artificial Neural Network

Recently artificial neural network (ANN) as a nonlinear interextrapolator is extensively used by hydrologists for precipitation modeling as well as other fields of hydrology. In the present study, wavelet analysis combined with artificial neural network and finally was compared with adaptive neurofuzzy system to predict the precipitation in Iran. For this purpose, the original time series using wavelet theory decomposed to multiple subtime series. Then, these subseries were applied as input data for artificial neural network, to predict daily precipitation, and compared with results of adaptive neurofuzzy system. The results showed that the combination of wavelet models and neural networks has a better performance than adaptive neurofuzzy system, and can be applied to predict both short- and long-term precipitations.

[4] Rainfall Prediction Using Hybrid Adaptive Neuro-Fuzzy Inference System (ANFIS) and Genetic Algorithm

The current rainy season is erratic and very difficult to predict the rain. It requires a method that can predict rainfall with the smallest error as possible. Adaptive Neuro-Fuzzy Inference System (ANFIS) is one of the prediction methods that are quite reliable because it is equipped with a network that can learn. The ANFIS uses Sugeno FIS in its architecture. To improve the prediction results, the Sugeno FIS will be optimized in boundaries of membership function and coefficient consequent rule before it goes into the process of training with ANFIS. A genetic algorithm is used for the optimization process. The results of rainfall prediction using hybrid ANFIS-GA are proven to produce smaller RMSE of rainfall prediction method that has never been done before. With two optimization process in the boundaries of membership function with genetic algorithm and the training process with ANFIS, RMSE values obtained from the rainfall prediction becomes lower. It can be concluded that the results of rainfall prediction using the hybrid method ANFIS-GA produce smaller RMSE compared to the previous methods such as GSTAR-SUR, Tsukamoto FIS, and hybrid Tsukamoto FIS with GA.

[5] Bayesian flood forecasting method

Bayesian forecasting system (BFS) offers an ideal theoretic framework for uncertainty quantification that can be developed for probabilistic flood forecasting via any deterministic hydrologic model. It provides suitable theoretical structure, empirically validated models and reasonable analytic-numerical computation method, and can be developed into various Bayesian forecasting approaches. This paper presents a comprehensive review on Bayesian forecasting approaches applied in flood forecasting from 1999 till now. Results show that the Bayesian flood forecasting approach is an effective and advanced way for flood estimation, it considers all sources of uncertainties and produces a predictive distribution of the river stage, river discharge or runoff, thus gives more accurate and reliable flood forecasts. Some emerging Bayesian forecasting methods were shown to overcome limitations of single model or fixed model weight and effectively reduce predictive uncertainty. In recent years, various Bayesian flood forecasting approaches have been developed and widely applied, but there is still room for improvements.

[6] Comparison of random forests and support vector machine for rainfall forecasting

This study aims to compare two machine learning techniques, random forests (RF) and support vector machine (SVM), for real-time radar-derived rainfall forecasting. The real-time radar-derived rainfall forecasting models use the present grid-based radar-derived rainfall as the output variable and use antecedent grid-based radar-derived rainfall, grid position (longitude and latitude) and elevation as the input variables to forecast 1-h to 3-h ahead rainfalls for all grids in a catchment. Grid-based radar-derived rainfalls of six typhoon events during 2012–2015 in three reservoir catchments are collected for model training and verifying. Two kinds of forecasting models are constructed and compared, which are single-mode forecasting model (SMFM) and multiple-mode forecasting model (MMFM) based on RF and SVM. The SMFM uses the same model for 1-h to 3-h ahead rainfall forecasting; the MMFM uses three different models for 1-h to 3-h ahead forecasting. According to forecasting performances, it reveals that the SMFMs give better performances than MMFMs and both SVM-based and RF-based SMFMs show satisfactory performances for 1-h ahead forecasting. However, for 2- and 3-h ahead forecasting, it is found that the RF-based SMFM underestimates the observed radar-derived rainfalls in most cases and the SVM-based SMFM can give better performances than RF-based SMFM.