Using Bayesian tree-based model integrated with genetic algorithm for streamflow forecasting in an urban basin

Duc Hai Nguyen*, Deg-Hyo Bae**

Abstract

Urban flood management is a crucial and challenging task, particularly in developed cities. Therefore, accurate prediction of urban flooding under heavy precipitation is critically important to address such a challenge. In recent years, machine learning techniques have received considerable attention for their strong learning ability and suitability for modeling complex and nonlinear hydrological processes. Moreover, a survey of the published literature finds that hybrid computational intelligent methods using nature-inspired algorithms have been increasingly employed to predict or simulate the streamflow with high reliability. The present study is aimed to propose a novel approach, an ensemble tree, Bayesian Additive Regression Trees (BART) model incorporating a nature-inspired algorithm to predict hourly multi-step ahead streamflow. For this reason, a hybrid intelligent model was developed, namely GA-BART, containing BART model integrating with Genetic algorithm (GA). The Jungrang urban basin located in Seoul, South Korea, was selected as a case study for the purpose. A database was established based on 39 heavy rainfall events during 2003 and 2020 that collected from the rain gauges and monitoring stations system in the basin. For the goal of this study, the different step ahead models will be developed based in the methods, including 1-hour, 2-hour, 3-hour, 4-hour, 5-hour, and 6-hour step ahead streamflow predictions. In addition, the comparison of the hybrid BART model with a baseline model such as super vector regression models is examined in this study. It is expected that the hybrid BART model has a robust performance and can be an optional choice in streamflow forecasting for urban basins.

Keywords : Bayesian Additive Regression Trees, Genetic algorithm, Streamflow forecasting, Urban floods.

Acknowledgements

This work was supported by Ministry of Science and ICT and Korea Environmental Industry & Technology Institute (KEITI) through the Water Management Research Program, funded by the Ministry of Environment (MOE) of Korea (130747).

* Member · Postdoctoral researcher, Dept. of Civil and Environ. Eng., Sejong University· · E-mail : haind@tlu.edu.vn

** Member · Professor, Dept. of Civil and Environ. Eng., Sejong University· · E-mail : dhbae@sejong.ac.kr