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Investigation of sensitivity of popular training methods to initial weights in ANN rainfall-runoff modeling

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Runoff estimation is a key input in any water resource management activity. It is generally estimated by developing rainfall-runoff (RR) models. There are many techniques employed for RR modeling and artificial neural network (ANN) is one of the popular methods among them. The gradient descent (GD) and Levenberg-Marquardt (LM) optimization methods are commonly adopted algorithms for the training of ANN models. It has been reported that the performance of these algorithms is always sensitive to their initial weights. In this paper, the sensitivity of these two training algorithms to initial weights in the performance of ANN-RR model was investigated. The best ANN architecture was determined using a trial and error procedure in which the number of hidden neurons was varied from 1 to 20 and the architecture giving best performance in terms of certain error statistics was selected as the best. Each of the twenty architectures was trained using BPA and LMA and the best architecture was selected, named ANN-BPA and ANN-LMA, respectively. Then, these best ANN architectures were trained on ten different set of initial weights using both BPA and LMA. The performance of the best ANN model trained by BPA and LMA on different initial weights was then compared using standard error statistical measures. The daily rainfall, runoff data derived from Bird creek basin, Oklahoma, USA have been employed to develop all the models included here. The input variables were selected on the basis of correlation analysis. The performance evaluation statistics such as average absolute relative error (AARE), Pearson's correlation coefficient (R) and threshold statistics (TS) were used for comparing all the models developed using both the optimization algorithm here. Based on the results obtained in this study, it has been found that the LMA trained ANN model performed better than the BPA trained ANN model. Further, the LMA trained ANN model is found to be more robust than the BPA trained ANN model as the ten different set of initial weights result into final solution similar to each other in case of the LMA trained ANN models.

Biography

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