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Streamflow Forecasting using Neuro-Fuzzy Inference System

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This paper presents combined approaches of neural network analysis and fuzzy inferencing techniques to the problem of streamflow forecasting. The physical system of the river basin that takes the rainfall as an input and produces the runoff is highly nonlinear, complicated and very difficult to fully comprehend. The system is influenced by large number of factors and variables. The large spatial extent of the systems forces the uncertainty into the hydrologic information. Therefore, it is practically very difficult to determine an appropriate model structure by using conventional modeling techniques. The relatively new soft computing technique of Adaptive Neuro-Fuzzy Inference System (ANFIS) is able to take care of the non-linearity, uncertainty, and vagueness embedded in the system. It is a judicious combination of the Neural Networks and fuzzy systems. It can learn and generalize highly nonlinear and uncertain phenomena due to the embedded neural network (NN). NN is efficient in learning and generalization, and the fuzzy system mimics the cognitive capability of human brain. Hence, ANFIS can learn the complicated processes involved in the basin and correlate the precipitation to the corresponding discharge.

In the present study, one step ahead forecasts are made for ten-daily flows, which are mostly required for short term operational planning of multipurpose reservoirs. A Neuro-Fuzzy model is developed to forecast ten-daily flows into the Hirakud reservoir on River Mahanadi in the state of Orissa in India. The input variables influencing the flows into the reservoir are identified using correlation analysis. The performance of the model is evaluated using various performance indicators and the results are presented. The results indicate that the Neuro-Fuzzy modeling technique is able to model the streamflow process with reasonable accuracy and can be used for real time forecasting of streamflows.