Summary 3 - A new hybrid artificial neural networks for rainfall–runoff

In this article, the main focus is again the AI but linked to the field of water resources through the Pre-Processed Eevolutionary Levenberg-Marquardt Neural Network (PELMNN) which is a model for runoff prediction and the hybrid nature of this model mixing the processing of various data, the field of water resources and the full-scale test of this prediction model on a real watershed.

Combining genetic algorithms, feed forward neural networks, and data pre-processing. The Aghchai watershed in Iran was chosen for testing the model's capability. The study discusses the importance of accurate rainfall-runoff process modeling for water resource management :

- Data-Driven Models (DDMs) are preferred when the user lacks complete physical understanding of the processes.
- The limitations of conventional time series models like *ARIMA* and *SARIMAX* in capturing non-stationarity and non-linearity in hydrologic data provide a rationale for adopting AI approaches.
- Authors emphasizes the success of Artificial Neural Networks or ANN in modeling rainfall-runoff phenomena due to their ability to capture complex non-linear relationships. The proposed model involves data pre-processing techniques such as data transformation, input variable selection, and data clustering, with a focus on improving accuracy.

About the architecture of the PELMNN model, it focus the importance of data normalization and input variable selection using Stepwise Regression Analysis or SRA. It includes K-means clustering for data segmentation into sub-populations. Genetic algorithms are used to evolve initial weights of neural networks, and the Levenberg-Marquardt back propagation algorithm is employed for local optimization. The study compares the performance of the PELMNN model with other models such as ANN, Adaptive Neuro Fuzzy Inference System or ANFIS, and Wavelet-ANN and Wavelet-Adaptive Neuro Fuzzy Inference System or WANFIS.

The results of the Aghchai watershed show that the PELMNN model outperforms these models in terms of prediction accuracy. The model's capability for multi-step ahead forecasting is also demonstrated, indicating its potential for accurate runoff prediction. The paper highlights the significance of data clustering in improving model accuracy and discusses the model's efficiency in capturing extreme values.

Finally, it highlights and prove at the samem time the superiority of the PELMNN model over WANFIS through hypothesis testing, demonstrating significantly lower average prediction errors. The model's enhanced capability in estimating peak values further supports its effectiveness in flood forecasting and water resource management. Overall, the PELMNN model presents promising results in capturing low-flow and extreme values, making it a powerful tool for streamflow forecasting. The combination of genetic algorithms, neural networks, and data pre-processing strategies in the PELMNN model proves to be an effective approach for improving prediction accuracy in a complex natural phenomenon like rainfall-runoff and paved the way for the prediction of further natural phenomenon.