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A HYBRID ARIMA AND ARTIFICIAL NEURAL NETWORK MODEL FOR SYNTHETIC STREAMFLOW GENERATION

Luiz Renato Martini Filho[1]
Daniel Henrique Marco Detzel[2]

ABSTRACT: For water resources planning and management, streamflow modeling and forecasting is essential in several subjects, such as, flood analysis and hazard mitigation systems, operation and planning of reservoirs, hydropower generation, among others. Good quality streamflow time series are of paramount importance for successfully fitting a hydrological model. However, the representativeness of such datasets may be a relevant issue to be considered. In situations when the historical register of a catchment has little available data, generating synthetic series by using stochastic models is a good way to overcome such problems. Thus, an ensemble of models capable to compute and replicate important statistical features of a series, namely Autoregressive Integrated Moving Average (ARIMA) type models, are still largely used for this purpose by many hydrologists worldwide, presenting a fair representation of the river regimen. However, a problem regarding ARIMA modelling is that those classic models are linear and fail to represent the non-linearity of streamflow and, thus, might not give the best result. Moreover, synthetic series using ARIMA models might present numerical issues related to the integration of the series, whilst Autoregressive Moving Average (ARMA) models, although useful in synthetic generation, are incapable to compute possible nonstationarities of a series. To illustrate such issues, Mann-Kendall and Pettitt statistical trend tests were performed for the Foz do Areia hydropower plant streamflow series, in the Iguaçu river basin. Two analyses were performed: (i) using the original data, and (ii) using residuals of the original data resulting of an ARMA filtering procedure. It is shown that the ARMA filter does not remove the trend detected in analysis (i), which hinders the use of such model for generating synthetic streamflow series. An alternative approach, possible to improve the quality of the results and adequate to deal with non-linear patterns and trends is the artificial neural network (ANN). The next steps of this research will consider the development and training of an ANN model and couple it with the ARIMA approach to produce a hybrid ARIMA-ANN model for streamflow synthetic series generation.

Palavras-chave: ARIMA model. Streamflow time series. Artificial neural network. Nonstationarity.

[1] Engenheiro Civil e Mestrando em Engenharia de Recursos Hídricos e Ambiental, Universidade Federal do Paraná, Curitiba, PR, luizrenato.martini@gmail.com
[2] Doutor em Engenharia de Recursos Hídricos e Ambiental, Universidade Federal do Paraná, Curitiba, PR, daniel@lactec.org.br