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How to transfer research efforts on data-driven modeling to technicians? The case of ANNs-MOGA

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The use of data-driven approaches is a hot topic for hydroinformatics. These paradigms have been experiencing a progressively increasing use for modeling natural and artificial systems. However, their success was often bounded to pilot/research application, whereas modelers and user are researchers. In this, the current effort is aimed at making these techniques accessible to a larger number of technicians and practitioners. Therefore, the use of common and easily available interfaces able to embed external functions, such as Ms-Excel, can allow for opening the use of data-driven tools to a wide plethora of end-users.
Artificial Neural Networks (ANN) [1] represent a typical methodology which is well established and widely used to model non-linear phenomena. ANNs produce fairly complex structures which model one or more outputs given an input data set. For ANN design, modelers must contend with the selection of the model's input, the determination of the number of hidden neurons and the selection of the appropriate transfer function. The ANN approaches have several advantages extensively investigated in literature [2][4].
ANNs-MOGA (Artificial Neural Networks – Multi-Objective Genetic Algorithm) is a tool developed on the homonymous modeling methodology based on the ANNs. The tool employs a particular structure of ANN named the Input-Output Neural Network (IONN) [4]. In particular, it is based on a MOGA approach for construction of IONN models, which prevents potential overfitting troubles caused by poor generalization capabilities of the identified ANNs [2]. This can be obtained by minimizing the model's input dimension and the number of hidden neurons (flexibility) while preserving fitness properties. Therefore, the most parsimonious and effective structure for the IONN is claimed, in order to influence its accuracy. This is here achieved in a multi-objective fashion by simultaneously minimizing three different cost functions: the fitness of returned models, the number of hidden neurons and the number of model input variables.
The approach used for multi-objective optimization is the Pareto dominance criterion, while to solve the combinatorial optimization problem of discerning the Pareto solutions set, an evolutionary approach based on a Multi-Objective Genetic Algorithm (MOGA) strategy has been adopted here [1]. More details about MOGA ANN can be found in [3].
Here the described methodology, originally developed in Matlab, is integrated into MS-Excel. This integration allows an easy selection of the input, using a spreadsheet, as well as an easy definition of the setting, through the proper section of a spreadsheet. Similarly the output results will be directly available into a further spreadsheet of an Excel file. This integration is proved not to bias the computational speed of the procedure, preserving the original efficiency of the tool. In this way, the end-user can perform multiple analysis of a system with an easy, effective and efficient ANN-based tool, overcoming the common hindrances to the use of such strategies.

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