

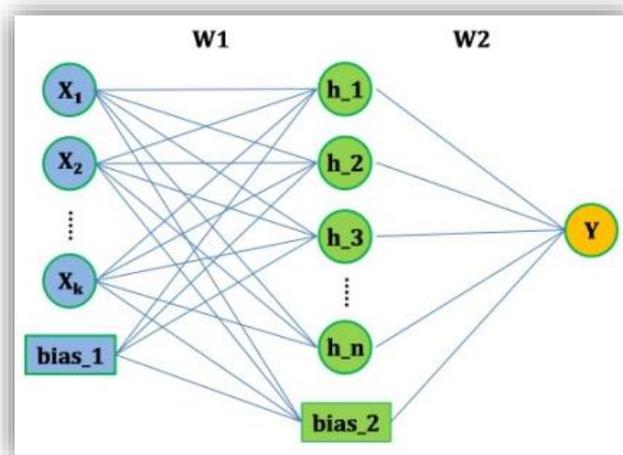


Data-driven models are really important for Hydroinformatics and these paradigms have been experiencing a progressively increasing use for modeling natural and artificial systems. Among them, Artificial Neural Networks are a typical data-driven technique, well established and widely used to model non-linear phenomena. However, their success was often limited to pilot/research application, whereas users are researchers.

The ANN-MOGA-XL is an add-in component of Excel of Microsoft Office that allows the user to build an ANN by exploiting a familiar environment to perform data-driven modeling.

Artificial Neural Networks by MOGA ANN MOGA-XL - Office Excel Add-in (1.0)					About ANN MOGA-XL					HELP	Syntax		Settings		Output			
Filename					Static					Start ANN-MOGA Analysis					Data		During ANN run	
Plot Option					Cartesian plot					SET DATA					Number of Runs			
Kernel Function					Hyperbolic Tangent										10			
Modelling Type					Dynamical Regression (time series)										Optimization Strategy			
Number of Hidden					3					Run ANN MOGA					Min (Hidden, Input, [1-CoDinf])			
[na nb nk]					2 1 1 <input checked="" type="checkbox"/> Add-inf										<input checked="" type="checkbox"/> Plot Results <input checked="" type="checkbox"/> Train a & b			
Prediction horizons					1 2 4 6													

ANN-MOGA (Artificial Neural Networks – Multi-Objective Genetic Algorithm) was a tool developed on the homonymous modeling methodology based on the Artificial Neural Network paradigm. The tool employs a particular structure of ANN named the Input-Output Neural Network (IONN).



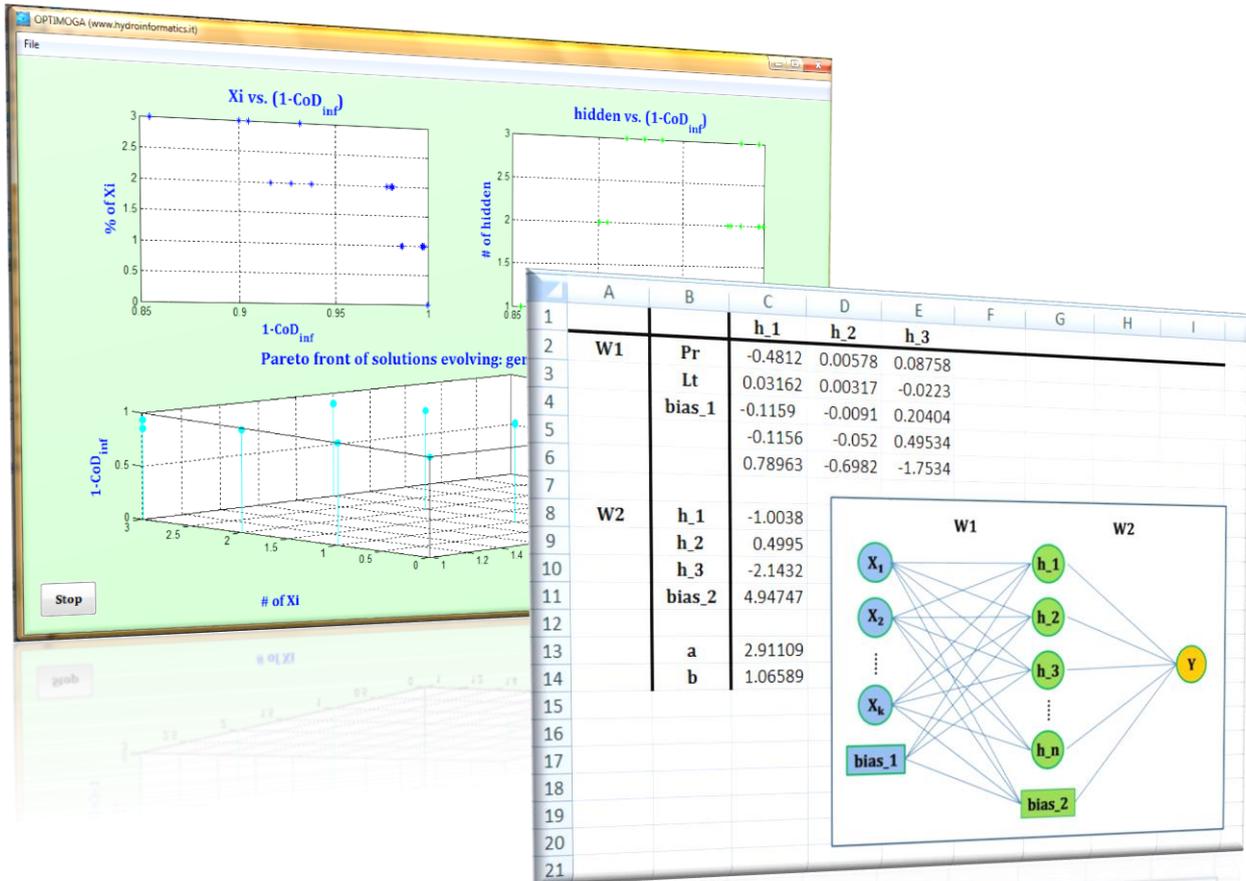
The general equation of an IONN, as implemented in ANN-MOGA, can be written as

$$Y(t|\mathbf{W1}, \mathbf{W2}, K) = \sum_{j=1}^h W2_j \cdot K_j \{ \mathbf{W1}, \Phi \} + W2_0$$

where $Y(t|\mathbf{W1}, \mathbf{W2}, K)$ is the model output, Φ is the model input, $\mathbf{W1}$ and $\mathbf{W2}$ are first and second layer weights of the IONN, respectively, and K is the kernel function of the j th neuron. Figure 1 show a graphical representation of this equation.

ANN-MOGA implements a multi-objective strategy based on the Pareto dominance criterion allowing for the generation of the Pareto front of non-dominated solutions. The space investigated comprises a vast ensemble of possible model structures comprising different number of inputs and/or hidden neurons among possible candidates.

The solutions are achieved by simultaneously minimizing three different objective functions: (i) the fitness of returned models, (ii) the number of hidden neurons, and (iii) the number of model input variables. Thus, the solutions belonging to the Pareto front are the best from both the parsimony (i.e. (ii) and (iii)) and fitness perspectives. To solve such a combinatorial optimization problem an evolutionary approach based on a multi-objective genetic algorithm strategy has been adopted (OPTIMOGA).



The ANN-MOGA strategy was originally developed in Matlab® and distributed as a stand-alone application. Nonetheless, its use was hampered for technicians and practitioners by the need of carefully preparing input data by following strict format requirements.

ANN-MOGA-XL has been developed to overcome previous drawbacks and facilitate the management of input and output data directly in MS-Excel. It can be launched by following the same basic syntactic rules of other MS-Excel functions. In order to facilitate multiple analyses, all the parameters (weights, inputs, hidden neurons, biases) of ANN model(s) obtained, the values model predictions and fitness indicators of each model are stored in a separate Excel file. This way, the end-user can perform multiple analysis based on previous results.

Since ANN-MOGA-XL is based on Matlab®, future modification and/or upgrade to match peculiar analysis needs are easily achievable without the burden of changing any data management tool.