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GROWING NEURAL MODELS FOR PROCESS IDENTIFICATION AND DATA ANALYSIS

Gancho Vachkov

Department of Reliability-based Information Systems Engineering
Faculty of Engineering, Kagawa University
Hayashi-cho 2217-10, Takamatsu City, Kagawa 761-0396, Japan
vachkov@eng.kagawa-u.ac.jp

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Abstract. *The paper proposes learning algorithms for two types of growing neural models that are able to improve their performance by gradually increasing the number of the neurons. The first type of growing model is based on the standard radial basis function network, while the second one is a special local linear mapping model. During the learning epochs, these models grow in size and gradually improve their prediction accuracy until a desired performance (prediction error) is achieved. The essential point here is that at each learning epoch, feedback information from the current approximation error of the model is utilized in order to learn the locations of the newly added neurons in the input space. Extensive performance evaluation and comparison of both growing models and their learning algorithms are shown in the paper on three test simulation examples, as well as on the benchmark gas-furnace data example. Finally it is shown that the newly proposed growing models achieve better approximation and generalization ability than the respective neural models produced by the standard "one-epoch full size" learning algorithms.*

Keywords: Neural model, Growing models, Radial basis function network, Local linear mapping, Error-driven learning, Neural-gas learning

1. Introduction.

Identification of complex nonlinear processes based on a collection of input-output data for revealing the unknown relationships between the process parameters is among the most important and difficult problems to be solved in the area of system engineering and data analysis. The satisfactory result of the identification would be a process model with good (desired) approximation and generalization ability.

The typical identification problem can be divided into several sub-problems such as choice of the model type, selection of the model structure (size of the model) and tuning of the model parameters.

As for the type of the process model, different neural network models [1-3] have been proposed and utilized for solving the general identification problem. Each of theses models has its merits and demerits in terms of computation time, required memory, efficiency and stability of the learning algorithm, as well as in terms of physical interpretability, generalization ability, robustness against noisy data, simplicity and practicability.

The Radial Basis Function Networks (RBFN) have been often preferred as typical universal approximators [3-5], but other approximation techniques and models, such as