THE APPLICATION OF NEURAL NETWORK IN MODEL GENERATION

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ABSTRACT In order to improve the performance of the model in terms of efficiency and accuracy, Artificial Neural Network (ANN) – a practical method for behavioral modeling of integrated circuits is studied. This method is used to replace the multi-dimensional lookup table model, which is one of models in DVHL modeling approach. The studies include the ANN structure, training algorithm and integrate ANN model and behavioral modeling tool.

BACKGROUND The DVHL modeling approach is an advanced technique for generating higher-level (behavioral) models for analog integrated circuits from the circuit description. In this approach, lookup tables have been used to represent the nonlinear voltage-controlled current source static characteristics. The interpolation method is used with the lookup tables to obtain the I-V characteristic at a certain point. However, the number of dimensions and the accuracy requirement will increase the storage of the model as well as the searching time as the model simulation expands. Therefore, a more accurate and computationally efficient method to deal with these data tables is required for the optimization of DVHL approach. Artificial Neural Networks have emerged as a powerful technique for modeling general input/output relationships. With a very well organized manner and sufficient training, the network is capable of approximating highly complex nonlinear functions. The ANN model can be more accurate, more efficient. Meanwhile, it allows more dimensions and much less storage than look-up table models.

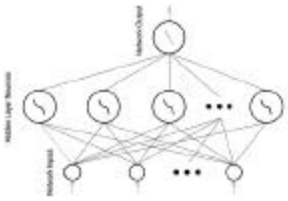

Figure 1 Neural network structure for Function approximation

WORK DONE For the ANNs, it is crucial to know which structure can be constructed and which training algorithm should be chosen for this particular application. Matlab Neural Network Toolbox has been hired to simulate different network topologies and training algorithms for approximating various data tables (including 1-D, 2-D and 3-D inputs tables). Qualitative analysis has been investigated in terms of the performance of various training algorithms. The result is shown in table1. The approach of applying ANN-based models to the higher-level behavioral model has also been studied.

Training Algorithm	Conver-gence Speed	Total CPU Time (Small/ Large NN)	Ease of Implementation	Memory Require-ment
Levenberg-Marquardt	Few	Small/Huge	Needs effort	Matrix
Conjugate-gradient	Medium	Small/Large	Needs effort	Vectors
Back propagation	Large	Large/Large	Easiest	Small vectors

Table1: Qualitative Comparison of the Performance of Various Neural Network Training Algorithms

RESULTS From the studies a network of two layers, where the first layer is sigmoid with proper number of neurons and the second layer is linear, can be trained to approximate any function. As stated in table1LM training algorithm is more adaptive to small ANN (small number of inputs /outputs). In a word, ANNs offer a more succinct representation of a multi-dimensional input-output mapping while maintaining speed and similar accuracy. Neural networks also offer an intrinsic ability to interpolate function values not in the table.

FUTURE WORK The next challenge will be to implement and test the complete ANN model in C++ and integrate it into our behavioral modeling tool.