Efficient Methods of Initializing Neuron Weights in Artificial Neural Networks Implemented in Hardware

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Abstract

An efficient initialization of neuron weights is one of the most important problems in case of artificial neural networks (ANNs) realized at the transistor level [1-3]. This problem is in particular important in large ANNs in which the number of the neuron weights becomes large. When ANNs are implemented as software systems, the weights can be easily programmed in the loops, so this problem is not a big issue. In contrast, in parallel systems of this type realized as application specific integrated circuits (ASIC) it is necessary to provide programming and addressing lines to each weight. This has a strong impact on the complexity of such circuits. In this paper we present various initialization methods of the neuron weights, suitable for both the analog and digital ANNs. Our investigations performed on the basis of the software model of the ANN show that Self-Organizing Maps (SOMs) in many situations may be trained even without the initialization (with zeroed weights). We present example results of several thousands simulations for different topologies of the SOM, for different neighborhood functions and different distance measures between the learning patterns and particular neurons in the input data space. Simulations were performed for initial values of the weights equal to zero, for small values (up to 1 % of full scale range) and for neurons randomly distributed over the overall input data space. The results are comparable. The conclusion is that usually only simple initialization methods are sufficient that allows to reduce the complexity of the SOM implemented in the CMOS technology.

References

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