

## DESIGNING OF A SYSTEM FOR SPEAKER INDEPENDENT SPEECH RECOGNITION USING NETWORKS OF SPIKING NEURONS

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**Research Programme: CNCSIS – TD**

**Duration: 2007 – 2008**

### ***Project objectives:***

The aim of this project was to develop a system which is able to perform speaker independent words recognition. This goal implies the completion of others secondary tasks which were:

- projecting and testing under real conditions of an biologically inspired model of spiking neurons
- developing a hardware architecture for splitting the audio signal spectral definition into frequency channels.
- adapting a solar source of energy to power the electronic neural network.

### ***Project description:***

The system which could be trained to recognize words independently of the speaker is composed of an audio module and a processing module. The audio module splits the audio signal spectrum into frequency channels and transforms the output of these channels into voltage pulses. The other module represents a network of spiking neurons which process the stimuli received from the audio module. The training of the network is done using Hebbian learning.

The processing unit of the artificial neural network is represented by a biologically inspired neuron. Being able to detect concurrent events and associate between them, the spiking neurons have a great potential for obtaining good results in physical environment understanding.

Being modeled in hardware, the neural network offers real time response due to parallel operation of the electronic components. Moreover the network response time does not depend on the number of neurons. However, the main disadvantage of this approach represents the big physical dimensions of the board which implement a considerable number of neurons, but the integration of the neural network in silicon overtakes this step back. Another advantage implied by the neuron design is the low energy needed for the neural network operation. This makes possible

to use efficiently a hybrid between photovoltaic energy and Li-ion battery to power the neural network.

The use of the electronic neuron as computation unit for artificial neural networks offers a good alternative for developing the control modules of the intelligent machines. Providing a very good accuracy in modeling the natural neuron physiology, it could be, also, used to understand the mechanisms which determine some neurological diseases.

The critical advantage of this approach of network implementation which is the independency between network response time and the number of neurons, make possible the increasing of the number of neurons to billions. Thus, when the neuroscientists will develop a method for reading the efficacies of the biological synapses, it will be possible to copy the synaptic configuration of a trained biological neural network to an artificial entity with the same number of neurons.

Therefore considering the high biological plausibility of the neuron model, the real time operation and the low power consume of the artificial network, the basics of a project which goal is to send into space artificial machines controlled by electronic copies of the human brain fall into place. These high intelligent machines powered by photovoltaic energy could explore the places from the universe where the life is not possible.

### ***Selected results:***

M.Hulea, "A biologically inspired model of spiking neurons suitable for analog IC design", Proceedings of The 2008 International Conference on Machine Learning: Models, Technologies and Applications, Las Vegas, Nevada, USA, CSREA Press, pp 807-813.

### ***Project director:***

Dr.ing. Mircea Hulea

[mhulea@eureka.cs.tuiasi.ro](mailto:mhulea@eureka.cs.tuiasi.ro); [mircea.hulea@yahoo.com](mailto:mircea.hulea@yahoo.com)