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CLASSIFICATION OF A NEURON

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There are already several classifications for neuron modeling. Namely, classified by successor features [1]:
- By form of information presentation (digital or analog);
- Type of element base (electronic, hybrid and opto-electron);
- - the nature of the setting of synapses (constant or variable);
- Signal transmission time (synchronous or asynchronous);
- By the nature of the adjustment of synapses (fixed or infused weights);
Among the optoelectronic element base can be divided into the following groups:
- Based on photodiodes and operational amplifiers;
- Based on managed banners;
- Based on optical bistable SEED-devices;
- Based on space-time modulators;An example of a digital one-bit model is the model of a formal neuron [2]. The model is based on the usual R-S trigger. I-No logic elements, transistors, and sometimes an ionotron transistor are also used. This model is very simplified because the input and output signals are binary.
More complex and promising are digital multi-bit neuron modeling devices (PMN) [3]. The advantage of this method is the high accuracy of modeling, but at the expense of high hardware costs.
In analog PMN information is presented as a voltage level. Such a representative is a device for reproducing the transfer function of a nerve cell. The main element [4] is an operational amplifier, because of this they have less accuracy, but are hardware simpler than multi-bit digital. Despite this, it is impossible to build large-scale neural networks at the expense of analog PMN.
The most common are PMN with frequency-pulse form of information presentation. Since, like biological neurons, information is represented by impulses, and the level of excitation is determined by the frequency. They are classified by hardware complexity into the following groups:
- The most complex - uses a digital element base (counter, triggers, etc.)
- Medium complexity - analog element base is used (operational amplifiers, comparators, etc.)
- The simplest - nonlinear electronic or optoelectronic elements are used (single transistor [5], avalanche transistor [6], thyristor [7], bispin device [8], Schmidt trigger on MOS transistors [9]).
The disadvantages of this class of devices are the use of electrical inputs and outputs and low load capacity.
There is also a more advanced scheme of a pulsed neural network [10] using an optoelectronic element base. The advantage is that the optical signal is used to organize connections between signals, which can be located in three dimensions and work simultaneously. And also with the help of hardware without computational procedures, training and retraining are possible.
The disadvantage of this system is the presence of optical elements that significantly increase the weight of the device. And the presence of cylindrical lenses increases the volume and requires a powerful source of radiation (laser).
Several requirements must be considered when developing a pulse model of a neuron:
1) Must be functionally adequate to the biological neuron:
2) Have optical inputs and outputs in the case of using optical nodes;
3) It is advisable to use electrical capacity to integrate signals into the neuron;
4) It is necessary to use a threshold device
5) There must be a circuit of the integrator (capacitance) to generate the input pulse.
A more generalized classification of INS divides them into two classes depending on the availability of feedback. In the absence of feedback, it is called static, and in its presence - dynamic (recurrent).
Another principle of classification is based on technology [11]:
- - fully connected: - each neuron transmits an output signal to other neurons and to itself. An example is the Hopfield network;
- - Multilayered - neurons are grouped into layers. The layer has neurons with one input signal;
- - unconnected - nerons are located in rectangular nodes or hexal lattice. Each neuron is connected to several neighbors;
- - Modular (nuclear) - belong to the class of direct distribution. Each neuron of the next layer receives a signal

from part of the neurons of the previous one. Thus, neurons of the nucleus are formed. inputs and outputs simultaneously. Each neuron is connected by synapses to other neurons and has its own synapse for signal input. Output signals are formed on axons.

Topics

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