THE USE OF NEURAL NETWORS IN TECHNICAL EDUCATION

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Abstract

A large amount of information which is desirable to process during the planning and control of production necessary requires the support of computer equipment. While forming the content of technical subjects we cannot forget the advanced methods of optimization including fuzzy logic, neural networks and generic algorithms. The aim of this article is to describe the neural network and the possibility of their use during the optimization course of manufacturing process.

Key words: information and communication technology, production planning and control, neural network.

VYUŽITIE NEURÓNOVÝCH SIETÍ V TECHNICKOM VZDELÁVANÍ

Resumé

Veľké množstvo informácií, ktoré je žiaduce spracovať počas plánovania a riadenia výroby vyžaduje nevyhnutne podporu výpočtovej techniky. Pri tvorbe obsahu technických predmetov nemožno zabudnúť ani na pokročilé metódy optimalizácie zahrňujúce fuzzy logiku, neurónové site a generické algoritmy. Cieľom článku je popísať neurónové siete a možnosť ich použitia pri optimalizácii priebehu výrobného procesu.

Klíčová slova: informačné a komunikačné technologie, plánovanie a riadenie výroby, neurónové siete.

Introduction

Information and communication technology take the crucial place in society. The main task in forming the content of technical subjects during an era of globalization is to prepare graduates with technical orientation to succeed in a rapidly changing world and to be able to successfully apply the new knowledge into practice.

Neural networks belong to the analytical tools which can be included under the concept of artificial intelligence. Artificial intelligence systems are closely linked with the development of information technology. Inspiration to create neural networks came from biological systems. It is actually a (rather imperfect) simulation of the brain. One of the most important properties of neural networks is that they are actually a universal function approximator. It often happens that we have a very complex system, whose description is practically impossible or would require absurdly much of computer time. But we have data that enter the system and to them corresponding outputs. In this situation we can use a suitable neural networks and try to learn it to behave like the reference system. This is an important moment, which determines the application of neural networks in practice.

Artificial intelligence systems can be used in many areas. In microeconomics neural network can be used to model business activities, production functions, in marketing studies, in managing the production process, etc.

1 Neural networks

Neural network is a massively parallel computing system, which has the ability to store information and allows their further processing while simulating the activity of the human brain in collecting of knowledge in the learning process (adaptability) and storing this knowledge using the connection between neurons (synaptic weights). If other parameters than connections between neurons, are used to store the data on the network (such as threshold parameters or coefficients of transition functions of neurons), we talk about adaptive networks. An essential element of the neural networks is neuron. In general, it has the number of inputs from other Nero or the environment, and one output. The operation, which transforms neurons inputs to the output is usually very simple.

According to the direction that spreads signals in neural networks can be divided into feed-forward and recurrent. Feed-forward neural networks are those in which the signal is spread only from the input neurons (neurons, whose inputs are signals from the environment) through the hidden neurons to output neurons (neurons, which leads out into the environment). Recurrent neural networks are those in which the signal can also move from the outputs to the hidden parts or even to the inputs. It is clear that recurrent neural networks are more complex than feed-forward.

One of the basic properties of neural networks is the ability to learn. Depending on what principle is this ability in neural networks realized, we distinguish two types of learning: supervised and unsupervised. Supervised learning is based on the fact that during the learning the network has at its disposal a set of inputs and their desired outputs. In the process of learning the network parameters (i.e. weights) are modified to minimize the difference between the obtained network response to inputs and outputs required for these inputs. Unsupervised learning is the type, in which the network has only inputs available, outputs corresponding to them are generated by the network based on the properties of the input data themselves. These outputs are not known in advance.

Feed-forward neural networks with supervised learning is very often used for their easy implementability and versatility of use. They are used for data classification, function approximation, prediction and modeling and identification of unknown systems. The most commonly used type of feed-forward neural networks with controlled learning is a multilayer perceptron. The neurons are arranged in one input, one output and one or more hidden layers.

From the recurrent neural networks with controlled learning the Hopfield neural networks are necessary to mention. Method of neuronal connections (ie network topology) in this type neural networks is very special: each neuron is the input and output simultaneously (so-called dual neurons) and is associated with all other neurons. Networks of this type are used to memory realization. We should also mention the fact that Hopfield neural networks can also be used to solve the traveling salesman problem.

The feed-forward neural networks with uncontrolled learning include particularly the Kohonen self-organized maps. Topologically they are very simple: they contain only one input and one output layer of neurons and no hidden neurons. Self-organizing maps can be hierarchically organized and then they become very powerful tool for clustering the data division. Their utility may increase even more when they are combined with fuzzy sets.

The last type of neural networks are recurrent networks with uncontrolled learning. Topology of neuronal connections and way of learning of these networks is generally based on Adaptive Resonance Theory. This method of learning allows the network to learn the correct response to new designs without having to "forget" the knowledge learned in the past.

2 The use of neural networks

Manufacturing enterprises are under strong domestic and foreign competition, which is still growing with the globalization of market environment. This situation is forcing manufacturers to adapt to new circumstances and to respond flexibly to the demands of their surroundings. The flexibility of the market depends on the production flexibility and shorter production cycles of products. The request to reduce overall production cycle, from the design of the product to its delivery to the customer with the lowest costs of production is the most important prerequisite for success business.

In this difficult situation plays an important role the system used for production planning and control. Large amount of information which is desirable to process during the production planning and control necessary requires the support of computer equipment. Production planning systems have the task of planning and managing the production to be optimal from capacity, economic and time aspects. It is the task of economic calculation, creating optimal annual, monthly, daily production plans with respect to production capacity, production facilities and the like.

In process optimization can be used advanced methods including fuzzy logic, neural networks and generic algorithms. Optimization problem is closely related to the costs minimizing which have a close relationship with a profit. The shorter the time of the production of products is and less number of machines and staff are needed, the lower are the costs. Optimization demo, and as further sub-part of the company management can be shown to the students, for example, through the problem of cutting plans and scheduling the production.

While creating the neural networks we have several options. Either programmed directly, mostly in C + + or Java, or use complex software, which enables to create neural networks directly in its environment, for example.: Math Works MATLAB, Wolfram Mathematica, STATISTICA, Neuro Solutions

In the MATLAB program we have to do the standard steps for designing neural networks to solve problems in four application areas: fiction fitting, pattern recognition, clustering, and time series analysis. The steps include: collect data, create the network, configure the network, initialize the weights and biases, train the network, validate the network, use the network. Data collection, while important, generally occurs outside the MATLAB environment.

We use the Import button to insert input data and target data to the Neural Network Toolbox. We can insert the data directly from disk or from the MATLAB workspace. The New button will create a network. MATLAB offers many options of settings network parameters. Create button adds the network set by us to the GUI (graphical user interfaces) Neural Network Toolbox. View tab automatically generates a scheme of the network. In the Train tab - Training Info we select input and output data.

The trained network can be directly simulate in the Neural Network Toolbox GUI or export to a workspace. Thus trained network is ready for use.

Conclusion

The very formation of the neural network, including data preparation, choice of number of layers, number of neurons in each layer, choice of training methods, activation functions, etc., is still matter of investigation and experimentation. Maybe that is why a neural networks has got a lot of attention among the scientific community.

Using the neural networks we can describe a complex high-dimensional data that cannot be described by simple rules or patterns in force in this data set is not easy to find by statistical methods.

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