DESCRIPTION FOR THE GENERAL PUBLIC

Intelligent devices become more prevalent in our lives. The development of machine intelligence is linked to solving many various scientific and engineering problems. Their solution requires rapid searching and identification of objects in a dynamically changing environment and acting on these objects in order to achieve defined objectives. Both objects as well as performed on them operations can be described through various patterns. Currently, there are no universal methods for representation and automatic consolidation of the various categories of patterns in a cognitive system to successfully operate on them and allow for the expansion of knowledge about the involved processes. There is a lack of machine learning methods allowing for automation of processes forming knowledge about the environment that the system needs to achieve its tasks.

The aim of the project is to create an artificial neural network inspired by the way of working of the human brain, allowing for cost-effective representation of various objects and operations performed on them. The network will have the task of responding to familiar and new situations using the acquired knowledge and ability to generalize.

Another objective of the proposed research is to develop new effective mechanisms of perception using a generalized idea of the motivated learning and new associative learning and reasoning mechanisms. Motivated learning will be applied in virtual robots working in specially designed for this purpose simulation environment as well as in physical robots operating in the real world. Motivated learning is to allow robots to identify goals and learn how to achieve them. The project also provides for expansion of incentive mechanisms in such a way that the action of the two cooperating robots could stimulate each other for a joint action. Robots will be equipped with perceptual mechanisms developed in this project. Environmental information will be collected via a system of cameras, microphones and distance meters. On this basis, the space-time patterns will be created and used for robot training. Operations of the sensory systems will be supported by specialized methods of image and sound processing. Associative neural system will generate signals to control robots in a virtual or real environment.

The scientific goal of this research is the development of new memory mechanisms capable of semantic and episodic representation of patterns from the environment. It is planned to build and test an innovative system of visual and acoustic perception for a robot based on the mechanisms of episodic memory. Our hypothesis is that the perception of visual and acoustic stimuli will bring the best results after applying the learning systems with memory, capable of collecting and modelling knowledge and creating associative memory for any spatio-temporal patterns. We will develop new associative mechanisms of contextual recalling of patterns established in these memories, supporting the achievement of the objectives. An important task is to achieve a generalization of the associative system operations to other cases.

The project will use parallel computing to imitate the natural operations of the nervous structures and to increase the efficiency of data processing. The project will try to prove the research hypothesis that the associative representation and exploitation of knowledge is possible in a manner similar to biological nervous systems.

Expected results of the proposed basic research will have an impact on the development of the next generation of robots, especially when performing operations and tasks with increasing autonomy, security, confidence and intelligence. Acquired knowledge can be applied in many fields for automatic perception, monitoring and recollection of the environment; location, detection and identification of interesting objects; making decisions based on understanding of the environment and external stimuli, and acting in cooperation with a human.