BIOLOGICAL NEURAL NETWORKS IN THE NEW TECHNIQUES FOR PHARMACOLOGY AND BIOMEDICINE

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Modern advances in field of investigation of biological neural networks functioning together with achievements in new biophysical techniques for electronic interfaces with neural cells, computer modeling and stem cell technologies open new tremendous possibilities for practical applications of cultured neural tissue in biomedicine, neurophysiology, and neuropharmacology [1, 2].

One of the aims of our work is to create an automated system for analysis of information processing state in the neural network in conditions of external informational and chemical (including pharmacological) influences. Modern systems of *in vitro* drug testing and screening usually relay on the data about state of single cells. However, we should monitor specific functional properties of neural network in order to estimate adequately drug or toxin action in case of neural tissue. The approach that we propose is based on the neural network cultured on the surface of planar microelectrode sensor. Specific patterns of stimulating electrical pulses sent via electrodes will formulate specific learning tasks for the network and recording electrodes will monitor task execution. In this case it will be possible to monitor influence of drugs on speed of neural network learning. The system will contain also the module of computer simulation of the neural network to provide new techniques of high-throughput drug screening.

Normal state of the network can be shifted by pharmacological or toxic modulation into pathological one, for example, epileptic. Such a pathological state can be investigated and appropriate drugs can be tested for their therapeutic action.

The field of applications of techniques proposed can be extended to stem cells derived neural networks. This kind of neural networks can be useful in prospective methods for transplantology in order to cure diseases such as stroke. Neural networks created artificially from human stem cells than can be tested by the system proposed for the ability to solve functional tasks. Stem cells deriver neural network will have varying synaptic connectivity at the different stages of development. This will lead to different activity patterns and functional properties. Such a biotechnologically formed neural network can be tested for ability to substitute neural tissue on the basis of estimation of its information processing capabilities.

References

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