Representation of the organs' and tissues' regeneration processes as a solution of some optimal control problems the criteria and methods of which are derived from the biological principles of evolutionary developmental biology

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According to the most general ideas of the theoretical biology the regulatory of the processes of maintaining the organs' and tissues' dynamic homeostasis occurs due to the self-organization with some perturbation.

In complex dynamic systems of interacting cells the phenomenon of self-organization is determined by the structure and properties of the network of intercellular interactions. It is assumed that the dynamic system of interacting cells is in an unstable equilibrium in the critical point domain (phase transition).

The structure and properties of the network of intercellular interactions is the organ's and tissue's morphology which is inherited and, consequently, is subordinated to the natural selection in the evolution process.

Hypothesis

Regulatory of the processes of maintaining / restoring organs' and tissues' dynamic homeostasis on the basis of self-organization occurs according to certain principles, the criteria of optimality that have developed during the organism evolution.

On the example of liver regeneration we will consider the criteria for optimality and the possible structure of the control system by the regeneration processes proceeding from the principles of evolutionary development biology.

It is natural to assume that the model for a virtual control system is a deep neural network. It follows that regulatory according to certain criteria of optimality based on self-organization in the biological system of interacting cells is analogous to the neurodynamic programming methods [1].

The representation of the regulation of biological processes as the solution of some optimal control problems is one possible way of solving problems in mathematical cellular biology which are connected with enormous complexity, criticality and not observability.

[1] Simon Haykin. Neural Networks: A Comprehensive Foundation.// Macmillan Coll Div. – 1994. – pp. 625 - 754.