Nonlinear system’s synthesis – the central problem of modern science and technology: synergetics conception. Part I: General Statements

(plenary report)

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Abstract: Our environment, such as natural, social, economics and engineering ones are the world of complex supersystems of various natures. These systems are collection of various subsystems providing defined functions and interconnected by processes of forced dynamics interaction and exchange of power, matter and information. These supersystems are nonlinear, multidimensional and multilinked. And in these systems are complex transients and has place of critical and chaotic modes. Problems of system synthesis, i.e. finding of common objective laws of control processes in a such dynamics system are much actual, complicated and, in many respects, practically inaccessible for present control theory.

In the report we consider fundamental basis of nonlinear theory of system’s synthesis based on synergetics approach in modern control theory as well as its application [1, 2].

The report consists of three parts: Part I General Statements; Part II Strategies of Synergetics control; Part III Synergetics synthesis of nonlinear systems with state observers.

Keywords: synergetics, system's synthesis, invariants, nonlinear systems, regulator’s design, chaotic disturbances

In our forming post-industrial informational society we can see more and more artificial controllers in the global system "society-technosphere-nature". The main attention of scientists, politicians and society is focused on the fundamental control problems related to energy-saving technologies, new organization of social-economical systems, ecological and nuclear safety of open society. In the XXI century in their technological activity people use new types of objects and processes being parts of rather complicated self-developing macro-systems. Such systems are known for cooperative phenomena that base not on power but on informational interactions. As a result of cooperative effects, the developing systems originate new structures without any external powered actions. In other words, complicated macrosystems give birth to self-organization processes that are studied by the modern science of nonlinear dynamics and synergetics. Such new cooperative phenomena in complicated macrosystems should be accounted in
development of effective strategies of human technological activity. These phenomena and strategies should be naturally included into the new progressive cognitive processes.

The modern sophisticated systems of various physical natures are a complex of various subsystems performing certain technological functions. They are connected by processes of intensive dynamic interaction and exchange of energy matter and information. These suspersystems are nonlinear, highly dimensional and multiply connected. They are a place for complicated transients, critical and chaotic motion modes. The problems of automatic control for such dynamic systems are important, extremely complicated and practically impossible to solve by the existing methods of the control theory. Here we present an instrument for solution of such problems. It is proposed to use the methods of the