Is Cybernetics a Motorway to the Future Heaven?

Interview with Dmitry Alexandrovich Novikov

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Professor Novikov, as the Deputy Director for Scientific Activities of the V.A. Trapeznikov Institute of Control Sciences, Russian Academy of Sciences, could you tell our readers some facts about this institute and its history?
The Trapeznikov Institute of Control Sciences was founded in 1939. In this period it was called the Institute of Automation and Remote Control. It was the time just before the II World War. First problems which were solved in the institute were the problems of automation in the industry, aviation, and during World War II also problems of production control. Then, just after World War II, we started intensive researches on space control. Director of the Institute at that time, Academician Boris Petrov, who was a colleague of Sergei Korolev, was responsible for the control systems in the space rockets. In 1970s Boris Petrov coordinated the Soyuz-Apollo Programme. And this class of control problems is developing till nowadays. Another branch which was born in the 1960s was the problem of complex automation of submarines and other marine objects that has been intensively developed until now in our Institute. Since 1980 we started researches on the problems of automation in the nuclear energy plants. These research activities are continued nowadays, we have close contact with Iran and India, atomic plant in Bushehr and Kudankulam.

Are people in Russia not afraid of nuclear plants?
Each new technology brings some new dangers. The nuclear energy is an obvious danger, but I think that people must not be afraid. To be afraid is a psychological category; it is a nature of common people to be afraid of something. We must do our best in science and technology in insuring the safety of the nuclear energy production, but we mustn't be afraid of nuclear plants because we have no alternatives. Do you think that information and communication technologies, such as mobile phones, Internet, social networks and so on, are not dangerous for mankind?

Definitely they are very dangerous.
Maybe much more dangerous than nuclear energy. I have published a book and a lot of papers about models of social networks but I do not use them in my daily life. Let's return to the history of our Institute. The institute was famous also for the theoretical researches in automation and remote control. Trapeznikov Institute was one of the organizers of the First International Congress of the International Federation of Automatic Control (IFAC) which was held in 1960 in Moscow. Head of one of our laboratories, Academician Alexander Lyotov was a co-president of this first congress. Now we have more than 50 laboratories and around 1000 researchers and engineers. List of the laboratories illustrates the variety of possible branches of control theory, from mathematical backgrounds to control in economical or ecological, biological, social systems, and so on, and so forth. I am sure that we have to predict the development of the control theory and have to forecast the emergence of new branches of control because now we are only starting to state and solve control problems for life and social systems. In 20 years it will be the mainstream in control

theory and we shall prepare to act in this mainstream by starting nowadays.
Nowadays our institute is still one of the world leaders in control. Our mission is to keep the integrity of different approaches in control and we mustn't loose and have to develop our achievements. We have to develop new spheres of control, for example social or medical systems. It is our mission in general but some details are changed very rapidly. Today at the conference we have discussed that nowadays approximately one half of applications are devoted to energy production and bio-medical systems. These spheres will dominate in control researches in the next 5–10 years.

What is the institutional structure of science in Russia? Do national research institutes, independent from the Russian Academy of Sciences – like PIAP in Poland, exist?

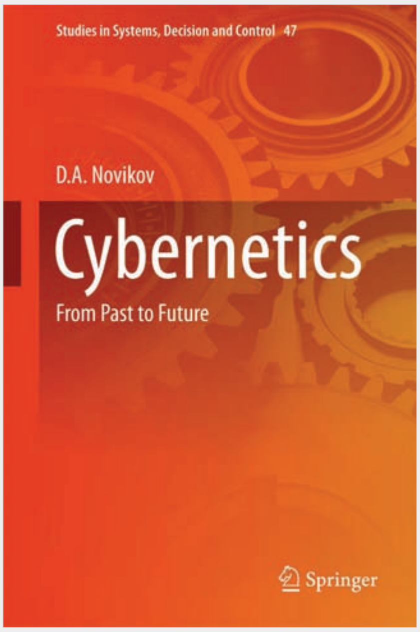
Scientific researches in Russia are concentrated in 3 main spheres: the first one is academic, the second one is industrial science, and the third one is the science at the universities.

So the structure is just like in Poland ...

The structure is the same but the devil lives in details. What about with the academic science? Three years ago there was issued a federal law according to which all academic institutions in Russia were transferred to the authority of the Federal Agency of Scientific Organizations, which was declared to be governing all the campuses, houses, water, electricity, etc., but not the science. The situation is dramatic because Russian Academy of Sciences itself, which had about 500 institutes, lost these institutes, and now Russian Academy of Sciences, according to this federal law, only has coordination functions. It coordinates the plans, accepts the results of the research and has some expert functions. It is my personal position, but I am sure that it was a strategic mistake in the development of science because managers could not govern the science. Scientist may be governed only by another scientist, and this idea was broken. Some industrial institutes which exist in Russia work on the quest of the proper branch of industry, for example aviation, space and so on, but this sector of science was essentially destroyed during and after the Perestroika. During the 90s years many institutes were destroyed or "sold", and we have lost an essential part of industrial science. Now there is a problem because, as you know, there is an innovational cycle, from fundamental science, through R&D, to applications and production. The state must fund fundamental sciences, which generally must not give certain results just now. Let's consider the experiments of Faraday and Maxwell in electricity – I think their results covered all the expenses for the science for all the future, because without electricity we cannot function today. In the stable situation, in proper construction of the innovation cycle, the state funds fundamental research, industry funds applied research, which has the request for fundamental research. If this chain is continuous, it works. But fundamental science is not able and must not be responsible for the production. I think that such a problems are typical not only for modern Russia but for many other countries, especially in Eastern Europe. Let's develop

„The main chance for cybernetics is the creation of the theory of organization."

Cybernetics. From Past to Future



Dmitry A. Novikov, **Cybernetics. From Past to Future**, Studies in Systems, Decision and Control, Vol. 47, Springer, 2016. ISBN 978-3-319-27396-9. DOI 10.1007/978-3-319-27397-6.

This book is a concise navigator across the history of cybernetics, its state-of-the-art and prospects. The evolution of cybernetics (from N. Wiener to the present day) and the reasons of its ups and downs are presented. The correlation of cybernetics with the philosophy and methodology of control, as well as with system theory and systems analysis is clearly demonstrated.

The book presents a detailed analysis focusing on the modern trends of research in cybernetics. A new development stage of cybernetics (the so-called cybernetics 2.0) is discussed as a science on general regularities of systems organization and control. The author substantiates the topicality of elaborating a new branch of cybernetics, i.e. organization theory which studies an organization as a property, process and system.
Table of contents:

- Cybernetics in the 20th Century,
- Cybernetics, Control Philosophy and Control Methodology,
- Laws, Regularities and Principles of Control,
- Systems Theory and Systems Analysis. Systems Engineering,
- Some Trends and Forecasts.

The book is intended for theoreticians and practitioners, as well as for students, postgraduates and doctoral candidates. In the first place, the target audience includes tutors and lecturers preparing courses on cybernetics, control theory and systems science.

the production, and then let's develop applied research. Let's fund fundamental science and when we will make a continuous chain, it will start working well and everybody will be happy, as well as the customer who is interested in results of this chain.

Do you see opportunities for contacts between Polish and Russian scientists currently? How you imagine these contacts?

Let's start from the very beginning. In the middle of XX century there were very close contacts between USSR and Poland. Many Polish professors did their PhDs in automation in our institute. 3rd IFAC world congress was held in Poland (1st in Russia, 2nd in USA). We had always very close ties with our colleagues from Poland. These ties became difficult during the perturbations in our countries but our connections were not interrupted. I remember when I was young PhD in early 90s, I was in Wroclaw at the conference on system science and systems engineering which was organized by Professor Zdzislaw Bubnicki. Three years later he came to our institute to a conference. So, these contacts certainly exist but maybe they are not so intensive. We must speak not about the opportunities for these contacts but about the measures to make these contacts more intensive. We are not able to invent anything radical because all forms are traditional. These forms are: conferences, special issues of journals, thematic books, maybe some applied projects. There is nothing new, but we should do it. Last year we have published several books by Springer, including the book titled New Frontiers in Information and Production Systems Modeling and Analysis – Incentive Mechanisms, Competence Management, Knowledge-based Production in the Series which is edited by professor Janusz Kacprzyk. Authors of this book are from our institute, Warsaw School of Informatics, and PIAP. Today we are speaking during the international conference, and I hope new contacts will start here and they will lead to new joint books.

You published a book titled "Cybernetics. From Past to Future" recently. Cybernetics is currently experiencing a renaissance. Can you identify the cause of this situation?

Indeed, cybernetics was very popular in 60s. Cybernetics was declared in 1948 by Norbert Wiener. It caused an explosion of the researches, theoretical and applied, in control theory, in theory of information transmission, as well as in many other branches of science and technology. A great amount of new results in technical systems control appeared rapidly. It became popular roundabout. There were several reasons for such a situation. The first reason is that the middle of 40s of XX century was the period of "explosion" in many, many branches of science. Game theory was born in 1943, as well as operations research. Atomic bomb was exploded first time in 1945, first nuclear plant appeared in 1954. First transistor and first computer appeared in the middle of 40s. It was a scientific and technical revolution. Another very important aspect was that Wiener and his colleagues were the representatives of different branches of science (W. Ashby was a physiologist, J. Neumann was a mathematician, S. Beer was a specialist in management, A. Rosenblueth was a physiologist, etc). These brilliant genius people understood that general laws and regularities are common for different sciences. It was a splash! This generalizations led to many new results. It was the golden age of cybernetics. Rapid development of theory and new applications lead to some overestimated expectations because people, not only scientists but common people, have heard from the scientific popu-

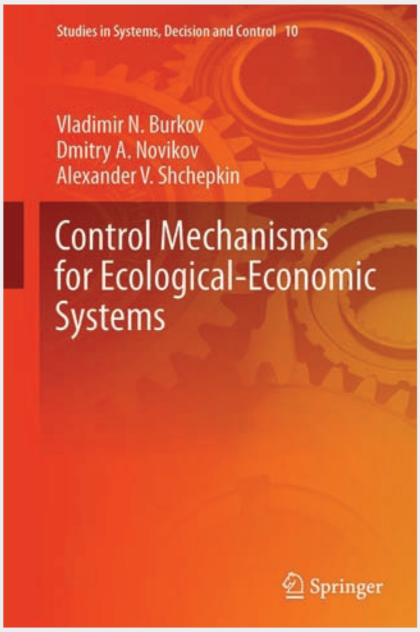
Control Mechanisms for Ecological-Economic Systems

This monograph presents and analyzes the optimization, game-theoretic and simulation models of control mechanisms for ecological-economic systems.

It is devoted to integrated assessment mechanisms for total risks and losses, penalty mechanisms, risk payment mechanisms, financing and costs compensation mechanisms for risk level reduction, sales mechanisms for risk level quotas, audit mechanisms, mechanisms for expected losses reduction, economic motivation mechanisms, optimization mechanisms for regional environmental (risk level reduction) programs, and mechanisms for authorities' interests coordination.

Table of contents:

The book is aiming at undergraduate and postgraduate students, as well as at experts in mathematical modeling and control of ecological economic, socioeconomic and organizational systems.



Vladimir N. Burkov, Dmitry A. Novikov, Alexander V. Shchepkin, **Control Mechanisms for Ecological-Economic Systems**, Studies in Systems, Decision and Control, Vol. 10, Springer, 2015. ISBN 978-3-319-10914-5. DOI 10.1007/978-3-319-10915-2.

lar journals, from TV, that cybernetic is powerful, it will solve all the problems just now – in technique, in the society, and so on. Expectations were very high, and the regret of these non-realistic expectations was proportional to them. Since the end of 70s, there was some regret about cybernetic. Most people lost their beliefs in the power of cybernetics. Maybe since that time cybernetics became having some negative sense because if you promised somebody something, and you did not fill your promises, everybody tell you that you promised but have not done. For 40 years (since 70s) cybernetics existed "in the shadow" and was not intensively developed. Maybe the reason is that cybernetics is a science about general regularities and laws of control and communication, while there were a lot of certain results in close sciences which have not done for cybernetics something really general. I am sure that modern and expected renaissance of cybernetics (we may call it "cybernetics 2.0") is based on the necessity of these generalizations, because intensive development of science lead to such a differentiation that the scientists sometimes cannot understand the specification of each other. There a lot of scientific journals, conferences, but there is a lack of general grounds of that branches of sciences. One of the missions of the cybernetics 2.0 is to bring a new general ground to the development of control systems of different kind: technical, economical, and social. We need these generalizations. That is why I hope that cybernetics has future. It explains how the world works in general, how the world is and must be controlled. This is the main strength of the cybernetics and the main challenge of cybernetics 2.0.

What are the other strengths of cybernetics?

When speaking about cybernetics Wiener mentioned control and communications in man, machine and society. I guess that the idea of "communication" may be interpreted more widely, not only as the transmission of or operating with information but as interdependence (including causal) among the processes, objects, and so on. It also may be called interconnection. There exists a term which embraces the laws and regularities of this interconnection. According to the Webster dictionary, there are three meanings of the term "organization": the first one is organization as the property – how a system organized, coordinated, and its elements are interconnected. The second meaning is the process of organization which results in the property of organization (you organize something). The third one is the organizational system which consists of people, groups, collectives with common goals and mechanisms of their joint activity coordination. Nowadays we need the well developed and structured theory of organization. If you open Internet or you go to the any bookshop, you'll find a lot of books which are titled "organization theory" but all these books are devoted to the theory of organizational systems, not mathematical theory but like a management one. Some best practices from managing organizations, but we need a general theory of organization which will give us general laws of the property of organization and the processes of organization. When we construct this theory, it will be the basis for the cybernetics 2.0, which includes Wiener's cybernetics as a particular case and will help us to explain some part of the world around us and make it a little bit better.

Warsaw, 2nd March 2016

Interview with
Dmitry Alexandrovich Novikov,
conducted by Anna Ładan

Dmitry Novikov, Doctor of Sc. (Tech., 1998), Professor (2002), Head of Control Sciences Department at the Moscow Institute of Physics and Technology, Corresponding member of Russian Academy of Sciences (2008).

Dmitry Novikov was born in 1970, Moscow, Russia. He is the leader of the theory of control in organizations. He is the author of dozens of books and hundreds of papers on different aspects of control and management. He is a deputy director of the V.A. Trapeznikov Institute of Control Sciences of Russian Academy of Sciences and head of Control Sciences department of Moscow Institute of Physics and Technology.

Personal WebPage (incl. the list of publications) – http://www.mtas.ru/person/novikov.php.


Fot. PIAP

V.A. Trapeznikov Institute of Control Sciences, Russian Academy of Sciences, was founded in 1939 in Moscow. The Council of People's Commissars decided in 1939 that the Commission on Remote Control and Automation that had existed since 1934 had to be expanded into an Institute of Automation and Remote Control in the framework of the USSR Academy of Sciences' Division of Technical Sciences The Institute was named after Academician Vadim Alexandrovich Trapeznikov (1905–1994) and Institute Director in 1951–1987, in 1998. Here (B.Ya. Kogan, V.A. Trapeznikov and others. Constructed a first Soviet family of analog computers. Of the Institute's nearly 1,000 staff over 120 are doctors and over 250, candidates of sciences. The Institute includes 53 laboratories and 4 research finding integration divisions. Basic lines of research are:

- System theory and general control theory;
- Techniques of control in complicated engineering and man-machine systems;
- Theory of control in inter-disciplinary models of organizational, social, economic, medical and biological and environment protection systems;
- Theory and techniques in development of software-and-hardware and engineering tools of control and complicated data processing and control systems;
- Scientific fundamentals oft in vehicle control and navigation;
- Scientific fundamentals of integrated control systems and automation of technological industrial processes.

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