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Ukrainian-Russian Seminar "Modern Tendencies in Control Theory of Dynamical Systems"

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In the range of October 3–5, 2012 Kiev held Ukrainian-Russian seminar devoted to modern problems of control theory of complex dynamical systems. The seminar was held at the Institute of Applied Systems Analysis of National Technical University of Ukraine "Kiev Polytechnic Institute" (NTUU "KPI") of Ministry of Education and Science, Youth and Sports (MESYS) and NAS of Ukraine and organized in frames of the project on holding joint scientific seminars of contests of NAS of Ukraine and Russian Foundation of Fundamental Research 2012 (Institute of Space Research of NAS of Ukraine and State Space Agency (SSA) of Ukraine was the organizer of the seminar). Academician of NAS of Ukraine V.M. Kuntsevich (Institute of Space Research of NAS of Ukraine and SSA of Ukraine) was the leader of seminar on the side of Ukraine and Academician of RAS A.B. Kurzhanski (M.V. Lomonosov Moscow State University (MSU) — on the side of Russia.

The work of seminar was featured by participation of Academician of NAS of Ukraine M.Z. Zgurovsky and Professor N.D .Pankratova (Institute of Applied Systems Analysis NTUU "KPI" of MESYS of Ukraine and NAS of Ukraine), Corresponding Members of RAS A.G. Chentsov and V.N. Ushakov (Institute of Mathematics and Mechanics of Ural department of RAS), Corresponding Member of NAS of Ukraine Chikriy (V.M. Glushkov Institute of Cybernetics of NAS of Ukraine) and Corresponding Member of NAS of Ukraine V.G. Gubarev (Institute of Space Research of NAS of Ukraine and SSA of Ukraine).

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Papers presented on the seminar were devoted to urgent control problems whose solution required radically new fundamental developments and research in the field of control.

A.B. Kurzhanski and V.M .Kuntsevich made reports on control of group motion in complex medium with obstacles (phase constraints). The lectures gave definitions of group motion and presented algorithms for their control which guarantee the fulfillment of problems set for a group of robots.

The seminar listened to lectures devoted to urgent problems of modern megapolises: their overburden with traffic flows. The statement of control problems of these flows and mathematical models of processes of their control and observations were the subject of lectures of research workers of M.V. Lomonosov MSU. They presented special results on control of large dimension systems using ellipsoidal approximations, the synthesis of systems with ultra-fast control, the application of finite observers at control synthesis and the account of communication constraints in control problems.

The lectures of research workers of Institute of Space Research of NAS of Ukraine and SSA of Ukraine reflected new results: methods of solving problems of guaranteed estimation of state vector of nonlinear dynamical systems under incomplete measurements or the presence of limited interferences and methods of control of multi-dimensional systems based on approximating models of low order obtained from identification.

Research workers of Institute of Applied System Analysis NTUU “KPI” gave lectures devoted to modern views on the systems analysis as a universal scientific methodology, its basis and methods — the powerful means for investigating, in particular, cyclic processes in economy and society as well as the control of complex technical systems guaranteeing their safe functioning in case of contingencies.

Some lectures of Ukrainian and Russian scientists were devoted to methods of determining attainability sets of nonlinear dynamical systems and game problems of dynamics. Research workers of Institute of Mathematics and Mechanics Ural Branch of RAS presented results on determining polyhedral estimates of attainability sets of dynamical systems with bilinear uncertainty and obtaining external estimates of attainability sets, and designing observers for nonlinear systems.

A series of lectures given by research workers of V.M. Glushkov Institute of Cybernetics of NAS of Ukraine dealt with game problems of dynamics of controlled systems. One of lectures gave a modern interpretation of method of resolving functions which gives, in particular, complete mathematical substantiation of parallel approaching and pursuit by ray methods known in practice. Therewith, one used the apparatus of multiple-values mappings and the technique of convex analysis. The individual investigation was devoted to differential games with integral limitations. This class of games is specific and while solving there occurs a series of complex problems of mathematical character. As a result there were obtained the sufficient conditions of a game completion in terms of the initial problem parameters.

A special attention was given to quasi-linear conflict-controlled processes with fractional derivatives and different ways of their determining. Presentations of solutions were obtained with resolving functions method employed for investigation.

Employing complex analysis method one successfully solves game problems with a terminal functional. Here one can successfully apply the technique of conjugate functions, support functions and Minkovski functionals.

The content of the discussed problems and the mathematical apparatus used therewith were helpful to all participants of the seminar and promoted creative atmosphere.

The joint seminar proved to be so important and helpful to scientists of Ukraine and Russia that the decision was made on advisability of next seminar being held in Russia.