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FELIKS LEONIDOVICH CHERNOUS'KO (On his 70th birthday)☆

Academician Feliks Leonidovich Chernous'ko, a prominent scientist in the fields of mechanics, control theory and applied mathematics and Editor-in-Chief of the *Journal of Applied Mathematics and Mechanics*, will celebrate his 70th birthday on May 16, 2008.

The range of his scientific interests and achievements is extremely broad; it covers the dynamics of rigid bodies with cavities filled with a fluid, optimal control theory, the theory of differential games, the theory of oscillations, asymptotic methods of non-linear mechanics, the theory of estimation of the phase state for dynamical systems, numerical methods of the variational calculus and optimal control, and robotics. In these fields he obtained fundamental results that have been internationally recognized. He is the author of more than 350 scientific publications, including 10 monographs.

His talent as a scientist had already been recognized when he was a student. In 1961, he graduated with honors from Moscow Institute of Physics and Technology. By that time he had already published 4 papers on gas dynamics and soil mechanics in the Journal of Applied Mathematics and Mechanics. One of these studies, "Convergent Shock Waves in a Gas of Variable Density", was awarded First Prize at the All-Union Competition of Student Scientific Papers. In 1963, he graduated ahead of schedule from postgraduate courses at the same Institute and received his Ph.D. degree for a dissertation on the dynamics of the rotation of satellites about the centre of mass.

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After his graduation from the postgraduate courses, from 1964 to 1968, he worked at the Computing Center of the USSR Academy of Sciences, where he performed fundamental research on the dynamics of rigid bodies with cavities containing a fluid. He studied the nature of the angular motions of the body, depending on the shape of the cavity, the degree of filling, and the viscosity of the fluid. His fundamental results in this field were of great importance in the design and development of spacecraft. For these investigations he received his Doctor of Science degree (1969) and was awarded the Lenin Komsomol Prize (1971).

At the same time, Chernous'ko was demonstrating an active interest in optimal control theory, to the development of which he has made a considerable contribution. His first studies in that area were related to the application of small parameter techniques, developed previously in non-linear mechanics, for solving control problems. Based on this concept, he developed an efficient method that enabled optimal controls for non-linear systems to be constructed in analytical form. This method was used to calculate stabilization and control modes for spacecraft. He proposed a method of successive approximations for the numerical solution of optimal control problems. This method was the first computational algorithm based on Pontryagin's maximum principle. He developed the local variation method for the numerical solution of variational problems of mechanics and control. Constructive in concepts, these methods appeared to be efficient in practical applications.

His further scientific activity has been associated with the Institute for Problems in Mechanics of the USSR Academy of Sciences (since 1992, the Institute for Problems in Mechanics of the Russian Academy of Sciences). He continues his studies in optimal control. He proposed and developed (jointly with L.D. Akulenko) an effective method for the approximate solution of optimal control problems for non-linear dynamical systems with a rapidly rotating phase. It was the first method in which Pontryagin's maximum principle was combined with Krylov–Bogolyubov's method of averaging. Using this method, a number of important optimal control problems for oscillatory and rotary processes, as well as for spacecraft orbital and attitude motions, were solved.

A number of fundamental results in the theory of control and observation with incomplete information or in conflict situations are due to him. He solved a series of typical problems of the control of motion under conditions of uncertainty that did not fall under the available generic differential game methods and demonstrated essential aspects of this new branch of control theory. He was the first to state and solve the pursuit differential game with delayed information, which is essential for a number of situations occurring in practice. Together with A.A. Melikyan, he studied an important class of differential games with alternating data acquisition, in particular, discrete-time data acquisition. It was shown that for a certain sequence of discrete-time observations, the pursuer can catch the evader in the same time as would have been the case for continuous observation. He proposed a solution of the problem of evasion of one object from a group of pursuers. He constructed the evasion strategy and gave a lower estimate for the minimum distance between the evader and the pursuers. He stated and solved a problem of the search for a moving object by another object in the case of restricted visibility, when either the observation range is restricted or the object to be detected is obstructed by an obstacle. Search strategies were proposed and sufficient conditions were indicated for the successful completion of the search. He stated and solved an optimization problem for the observation process with constrained total duration of the observations, as well as a self-similar problem of optimal correction of the motion subject to random perturbations. These pioneering papers initiated numerous studies of control processes in stochastic systems.

He developed an efficient approach to the construction of feedback controls for non-linear mechanical systems governed by Lagrange's equations. This approach involves the decomposition of a coupled multi-degree-of-freedom system into simple single-degree-of-freedom subsystems, each of which can be controlled independently. It enables the mechanical system subject to uncontrolled disturbances to be steered to a prescribed state in a finite time by means of constrained controls. This approach was utilized to calculate control modes for multi-link robotic systems.

Beginning in the 1980s, he investigated a new class of problems of optimal estimation of attainable sets for controlled systems. He developed a theory and techniques for the optimal estimation of attainable sets for linear systems by means of ellipsoids. He extended his theory to non-linear systems and to the case of several approximating ellipsoids. The construction of external and internal ellipsoidal approximations of the attainable sets is reduced to the solution of appropriate initial-value (Cauchy) problems for special non-linear systems of differential equations. He also investigated the properties of these systems and constructed explicit solutions of the Cauchy problems in a number of cases. The proposed ellipsoidal estimates of the attainable sets enable a number of important problems of control and estimation to be solved and reliable bilateral estimates to be obtained. Among these problems are those of controllability, optimal control, estimation of the influence of perturbations on the motion of mechanical systems, differential games, and guaranteed filtering of observation results. His studies on the ellipsoid method have been widely recognized in Russia and abroad and have been utilized in theoretical and applied investigations.

He has made a considerable contribution to the development of the scientific foundation of robotics. Combining asymptotic and numerical methods of non-linear mechanics, he developed an efficient approach to the simulation of the dynamics of multi-link manipulators with elastically compliant links and joints. This approach was utilized when investigating the influence of the elastic compliance on the positioning accuracy for universal industrial robots and a number of special robotic systems.

He introduced the fundamental concept of the guaranteed equilibrium for a rigid body in contact with a rigid surface in the presence of dry friction and obtained the conditions for such an equilibrium in terms of the parameters that characterize the contact area, the external forces and friction. These results were used to calculate the design parameters of wall climbing robots that are kept on a vertical surface by means of vacuum holders (suckers), as well as the operating modes of vacuum pumps to provide reliable contact of the robot with the surface for design loads.

He calculated the optimal parameters for the gaits of a unique tube-crawling robot built at Munich Technical University. Together with his colleagues, he solved a number of basic optimal control problems for the electric drives of manipulation robots.

He proposed a new concept of motion of mobile robots in a resistive medium without special propellers, due to the change in the robot's configuration or the motion of internal masses. This concept can be utilized for hermetic mini- and micro-robots that do not have protruding components and are suitable for engineering and medical diagnostics.

He was the initiator of the organization of the Robotics and Mechatronics Laboratory at the Institute for Problems in Mechanics of the USSR Academy of Sciences for experimental studies in the field of the mechanics and control of robotic systems. This laboratory was set up in 1981.

He fruitfully combines his research and pedagogical activities. For more than 40 years he has taught at the Moscow Institute of Physics and Technology, supervised the research work of undergraduate and graduate students, and headed the Chair of Mechanics and Control Processes. He has built up a leading scientific school in Russia in the field of control theory. Since 1996, this school has had a grant from the State Programme for Support of Leading Scientific Schools in Russia. Fourteen of his former students have received a Doctor of Sciences degree and more than 30 have received a Ph.D. degree.

He carries out considerable work for organization in science. For 39 years he was the Head of the Laboratory of Control of Mechanical Systems at the Institute for Problems in Mechanics of the Russian Academy of Sciences, and since 2004 he has been the Director of this Institute. For more than 40 years he has headed the scientific Seminar on System Dynamics and Control Theory at the Institute that has a considerable reputation through ant Russia. Quite often, foreign scientists present their results at this seminar.

He is a member of the Bureau of the Department of Power Engineering, Mechanical Engineering, Mechanics, and Control Processes of the Russian Academy of Sciences, a Deputy Chairman of the Russian National Committee on Theoretical and Applied Mechanics, a member of the Russian National Committee on Automatic Control, and a member of editorial boards of a number of journals of the Russian Academy of Sciences and international journals. He is the Principal Manager of the Programme of the Russian Academy of Sciences "Control Processes", aimed at developing basic research in this field. Twenty-two projects have been set up within the framework of this program at 16 institutes of the Russian Academy of Sciences in 12 cities from the Central Region of Russia, Siberia, and the Far East.

His outstanding achievements in science have been recognized in Russia and abroad. He was elected a Corresponding Member of the USSR Academy of Sciences in 1987 and a Full Member of the Russian Academy of Sciences in 1992. He is a Laureate of the State Prize of the USSR and the State Prize of the Russian Federation for Science and Technology. He is a member of the European Academy of Sciences, the Serbian Academy of Sciences and Arts, the International Astronautical Academy, the Academy of Sciences of Serbia and Montenegro, and an honorary member of the International Physics and Control Society. He has been awarded the Koerber Prize for European Science (Germany, 1993), the Humboldt Prize (Germany, 1998), and the Chaplygin Golden Medal of the Russian Academy of Sciences (2005).

The Editorial Board, editors, and readers of the *Journal of Applied Mathematics and Mechanics* cordially congratulate Feliks Leonidovich Chernous'ko on his 70th birthday and wish him good health, fruitful creative work in science, and happiness.

Translated by N.N.B.

Appendix A. LIST OF THE MAIN SCIENTIFIC PUBLICATIONS OF F.L. CHERNOUS'KO

1960

A converging shock wave in a gas of variable density. *J appl Math Mech* 1960;**24** (5):1334–48.

1961

One-dimensional quasi-statical motions of soil. *J Appl Math Mech* 1961;**25** (1):119–37 (coauthor with S.S. Grigoryan).

The reflection of weak converging shock waves in a gas of variable density. *J Appl Math Mech* 1961;**25** (2):311–23.

The piston problem for the equations of soil dynamics. *J Appl Math Mech* 1961;**25** (5):1300–23 (coauthor with S.S. Grigoryan).

1962

On motion of an ideal fluid with a pressure discontinuity along the boundaries. *J Appl Math Mech* 1962;**26** (2):543–8.

On a method of successive approximations for the solution of problems of optimal control. *USSR Comput Math Math phys* 1962;**2** (6):1371–82 (coauthor with I.A. Krylov).

1963

On resonance in an essentially non-linear system. *USSR Comput Math Math Phys* 1963;**3** (1):168–85.

Resonance phenomena in the motion of a satellite relative to its mass center. *SSR Comput Math Math Phys* 1963;**3** (3):699–713.

On the motion of a satellite about its center of mass under the action of gravitational moments. *J Appl Math Mech* 1963;**27** (3):708–22.

Study of satellite motion about center of mass using averaging method. In: *Proc 14th Int Astronaut Congr*. Paris; 1963; Vol. 1V.10, 143–54.

1964

On the stability of regular procession of a satellite. *J Appl Math Mech* 1964;**28** (1):181–4.

Motion of a solid body with a cavity containing an ideal fluid and an air bubble. *J Appl Math Mech* 1964;**28** (4):896–907.

1965

Asymptotic methods for the solution of some problems of satellite dynamics. In: *Proc 15th Int Astronaut Congr*. Paris: Gauthier-Villars; 1965: Vol. I, 277–96 (coauthor with Yu. G. Yevtushenko).

Asymptotic methods of non-linear mechanics, associated with averaging. In: *Proc 2nd All-Union Congress on Theoretical and Applied Mechanics*. Moscow: Nauka; 1965: No. 2, 35–50 (coauthor with V.M. Volosov, N.N. Moiseyev and B.I. Morgunov).

Self-similar motion of a liquid under the action of surface tension. *J Appl Math Mech* 1965;**29** (1):57–64.

A local variation methof for the numerical solution of variational problems. *USSR Comp Math Math Phys* 1965;**5** (4):234–42.

Motion of a thin fluid layer under the action of gravity and surface forces. *Mat Mekh* 1965;**29** (5):1013–20.

Motion of a rigid body with cavities filled with viscous fluid at small Reynolds numbers. *USS Comp Math Math Phys* 1965;**5** (6):99–127.

Problems on the oscillation of a fluid subject to surface tension forces. *USSR Comp Math Math Phys* 1965;**5** (6):128–60 (coauthor with N.N. Moiseyev).

1966

Solution of problems of optimal control by the method of local variations. *USSR Comp Math Math Phys* 1966;**6** (2):12–31 (coauthor with I.A. Krylov).

Motion of a body with a cavity filled with a viscous fluid, at large Reynolds numbers. *J Appl Math Mech* 1966;**30** (3):568–89.

On free oscillations of a viscous fluid in a vessel. *J Appl Math Mech* 1966;**30** (5):990–1003.

Determining the equilibrium form of a liquid subject to gravity forces and surface tension. *Fluid Dynamics* 1966;**1** (5):109–12 (coauthor with V.M. Petrov).

The solution of variational and boundary-value problems by the method of local variations. *USSR Comp Math Math Phys* 1966;**6** (6):1–21 (coauthor with N.V. Banichuk and V.M. Petrov).

The motion of a body with a cavity partly filled with a viscous liquid. *J Appl Math Mech* 1966;**30** (6):1167–84.

1967

Oscillations of a vessel containing a viscous fluid. *Fluid Dynamics* 1967;**2** (1):39–43.

The oscillations of a rigid body with a cavity filled with a viscous liquid. *Inzh Zh MTT* 1967;(1):3–14.

Rotational motions of a solid body with a cavity filled with fluid. *J Appl Math Mech* 1967;**31** (3):451–64.

Optimal search for a zero of a function computed approximately. *Soviet Math Dokl* 1967;**8** (6):1382–5.

1968

Some problems of optimal control with a small parameter. *J Appl Math Mech* 1968;**32** (1):12–22.

Motion of a solid containing a spherical damper. *J Appl Mech Tech Phys* 1968;**9** (1):45–8.

Optimum correction under active disturbances. *J Appl Math Mech* 1968;**32** (2):196–200.

Optimal control minimizing the extremum of function of phase coordinates. *Cybernetics and Systems Analysis* 1968;**4** (3):43–7 (coauthor with A.G. Kuznetsov).

The problem of the equilibrium of a liquid subject to forces of gravity and surface tension. *In: Introduction to the Dynamics of a Body with a Liquid under Conditions of Weightlessness*. Moscow: VTs Akad Nauk SSSR; 1968: 69–97.

An optimal algorithm for finding the roots of an approximately computed function. *USSR Comput Math Math Phys* 1968;**8** (4):1–23.

A minimax problem of one-time correction with measurement errors. *J Appl Math Mech* 1968;**32** (4):609–17.

The motion of a rigid body with cavities containing a viscous liquid. Moscow: VTs Akad Nauk SSSR; 1968.

1969

On optimization of the tracking process. *J Appl Math Mech* 1969;**33** (1):90–104.

An algorithm of the method of local variations for solving variational problems with a single independent variable. In: *Algorithms and Algorithmic Languages*. Moscow: VTs Akad Nauk SSSR; 1969: No. 4, 64-76 (coauthor with N.V. Banichuk, I.A. Krylov and V.M. Petrov).

Solution of nonlinear heat-conduction problems in a medium with phase transitions. *J Appl Mech Tech Phys* (1969);**10** (2): 167–75.

The method of local variations for variational problems involving non-additive functionals. *USSR Comput Math Math Phys* 1969;**9** (3):66–76 (coauthor with N.V. Banichuk and V.M. Petrov).

Optimizing the tracking process under random perturbations. *J Appl Math Mech* 1969;**33** (4):696–705 (coauthor with A.I. Solyanik).

Differential games with information delay. *Soviet Physics Dokl* 1970;**14** (10):952–4.

1970

Motion of a liquid bounded by a flexible film. *Fluid Dynamics* 1970;**5** (1):91–8.

On optimal algorithms for search. In: *Lecture Notes in Mathematics. 112. Colloq. on Methods of Optimization*. Berlin: Springer; 1970: 95–103.

Optimal search for the extrema of unimodal functions. *USSR Comp Math Math Phys* 1970;**10** (4):146–61.

The problem of the optimal multi-impulse correction of perturbations. *Avtomatika Telemekhanika* 1970;(8):59–66 (coauthor with V.K. Gorbunov).

Differential games with information lag. *J Appl Math Mech* 1970;**34** (5):779–85 (coauthor with B.N. Sokolov).

On optimal search for the minimum of a convex function. *USSR Comput Math Math Phys* 1970;**10** (6):20–3.

1971

Self-similar solutions of the Bellman equation for optimal correction of random disturbances. *J Appl Math Mech* 1971;**35** (2):291–300.

An algorithm of the method of successive approximations for solving problems of optimal control. Preprint No. 3. Moscow: Inst Probl Mekh Akad Nauk SSSR; 1971 (coauthor with I.A. Krylov).

An algorithm of the method of local variations for problems with partial derivatives. Preprint No. 4. Moscow: Inst Probl Mekh Akad Nauk SSSR; 1971 (coauthor with N.V. Banichuk and V.M. Petrov).

The equilibrium of a liquid bounded by a flexible film. *Izv Akad Nauk SSSR MTT* 1971;(4):131–42 (coauthor with V.M. Petrov).

The motion of a gyroscope with a non-contact suspension. Preprint No. 9. Moscow: Inst Probl Mekh Akad Nauk SSSR; 1971 (coauthor with D.M. Klimov and G.N. Kosmodem'yanskaya).

Certain minimax control problems with incomplete information. *J Appl Math Mech* 1971;**35** (6):907–16 (coauthor with A.A. Melikyan).

Problems of optimal control with incomplete information. In: *Proc 4th Winter School on Mathematical Programming and Related Issues*. Drogobych; 1971: No. 1, 5–120 (coauthor with V.B. Kolmanovskii).

1972

An algorithm for the method of successive approximations in optimal control problems. *USSR Comput Math Math Phys* 1972;**12** (1):15–38 (coauthor with I.A. Krylov).

The numerical solution of the axisymmetric problem of the indentation of a punch in an elasto-plastic medium. *Izv Akad Nauk SSSR MTT* 1972;(1):50–7 (coauthor with N.V. Banichuk and V.M. Kartvelishvili).

Differential games with variable information conditions. *Dokl Akad Nauk SSSR* 1972;**203** (1):46–9 (coauthor with A.A. Melikyan).

The motion of a gyroscope with a non-contact suspension. *Izv Akad Nauk SSSR MTT* 1972;(2):3–8 (coauthor with D. M. Klimov and G.N. Kosmodem'yanskaya).

Optimization of disturbances in the observation of a dynamical system. *Izv Akad Nauk SSSR Tekhn Kibernetika* 1972;(2):170–6 (coauthor with V.B. Kolmanovskii).

Optimization of control and observation processes in a dynamical system when there are random perturbations. *Avtomatika Telemekhanika* 1972;(4): 42–9.

Numeryczne rozwiazywanie zagadnien sprezysto-plastycznych metoda lokalnych wariacji. *Rozpr Inz* 1972;**20** (3):343–50.

Approximate synthesis method for optimal control of a system subjected to random perturbations. *J Appl Math Mech* 1972;**36** (5):780–9 (coauthor with A.I. Solyanik).

Weight factors in expert estimates. *Cybernetics and Systems Analysis* 1972;**8** (6):1021–4.

1973

The method of local variations for numerical solutions of elastic-plastic problems. In: *Paper Int Symp Foundat Plasticity*. Leyden: Noordhof Publ; 1973: Vol. 1, 519–33 (coauthor with N.V. Banichuk).

An algorithm and problems of the convergence of the method of local variations for problems with partial derivatives. *USSR Comput Math Math Phys* 1973;**13** (1):59–72. (coauthor with N.V. Banichuk and V.M. Petrov).

Computational methods of optimal control. In: *Mathematics at the Service of the Engineer. Principles of the Theory of Optimal Control*. Moscow: Znaniye; 1973: 56–73.

Motion of a rigid body with moving internal masses. *Mechanics of Solids* 1973;**8** (4):27–36.

Variational Problems of Mechanics and Control. Numerical Methods. Moscow: Nauka; 1973 (coauthor with N.V. Banichuk).

1974

Numerical solution of problems of optimal correction when random disturbances are present. *USSR Comput Math Phys* 1974;**14** (1):69–79 (coauthor with A.S. Bratus').

Problems of the mechanics of liquid under conditions close to weightlessness. In: *12th Yugosl Congr on Theoretical and Applied Mechanics*. Ohrid; 1974: B1.1, 1–8.

The method of local variations in problems of elasticity and plasticity. Investigation of convergence. In: *Proc 3rd All-Union Conf on Numerical Methods for Solving Problems of the Theory of Elasticity and Plasticity*. Novosibirsk: VTs SO Akad Nauk; 1974: Part 1, 12–21 (coauthor with N.V. Banichuk).

1975

Problems of the mechanics of flexible films containing liquid masses. In: *Progress in Mechanics of Deformable Media*. Moscow: Nauka; 1975: 324–39 (coauthor with R.P. Kuz'mina and V.M. Petrov).

Determination of the optimum and quasi-optimum controls in on oscillatory mechanical system. *Mechanics of Solids* 1975;**10** (2):1–6 (coauthor with N.V. Banichuk).

Some differential games with incomplete information. In: *Lecture Notes in Computer Sciences. 27. Optimization Techniques. IFIP Techn Conf*. Berlin: Springer; 1975: 445–50 (coauthor with A.A. Melikyan).

The averaging method in optimal control problems. *USSR Comput Math Math Phys* 1975;**15** (4):54–67 (coauthor with L.D. Akulenko).

Optimal impulse correction under random perturbations. *J Appl Math Mech* 1975;**39** (5):767–75 (coauthor with M.Yu. Borodovskii and A.S. Bratus').

Optimum translation of a pendulum. *J Appl Math Mech* 1975;**39** (5):775–86.

Variational-difference methods and problems of their convergence. Preprint No. 60. Moscow: Inst Probl Mekh Akad Nauk SSSR. 1975 (coauthor with N.V. Banichuk and V.M. Kartvelishvili).

Optimal control of the displacement of loads. Preprint No. 62. Moscow: Inst Probl Mekh Akad Nauk; 1975 (coauthor with N.V. Banichuk and V.M. Mamalyga).

The dynamics of a rigid body with moving internal masses. In: *Theoretical and Applied Mechanics. Papers of 2nd National Conference. Book 1*. Sofiya: Izd Bolg Akad Nauk; 1975: 212–9.

1976

A problem of evasion from many pursuers. J Appl Math Mech 1976;**40** (1):11–20.

The optimal control of some oscillating systems. *Teor Primen Mehanika Beograd* 1976;(2):25–31.

The optimal displacement of suspended loads. Preprint No. 74. Moscow: Inst Probl Mekh Akad Nauk SSSR; 1976 (coauthor with N.I. Yerofeyev, B.N. Sokolov, P.M. Strel'tsov and V.V. Kokorzhitskii).

On optimal displacement of suspended cargo. *Mechanics of Solids* 1976;**11** (4):20–26 (coauthor with B.N. Sokolov).

Numerical variational methods and problems of difference approximation. In: *Numerical Methods of Non-linear Programming. 2nd All-Union Seminar*. Khar'kov; 1976: 50–4 (coauthor with N.V. Banichuk and V.M. Kartvelishvili).

The numerical solution of stochastic problems of optimal control. In: *Numerical Methods of Non-linear Programming. 2nd All-Union Seminar*. Khar'kov; 1976: 328–32 (coauthor with A.S. Bratus' and M.Yu. Borodovskii).

Difference-quadrature approximations of convex integral functionals. *Dokl Akad Nauk SSSR* 1976;**231** (2):269–72 (coauthor with N.V. Banichuk and V.M. Kartvelishvili).

Variational-difference methods in extremum problems with constraints. In: *Numerical Methods for Solving Problems of the Theory of Elasticity and Plasticity. Proceedings of the 4th All-Union Conference*. Novosibirsk: VTs SO Akad Nauk SSSR; 1976: Part 1, 35–45 (coauthor with N.V. Banichuk and V.M. Kartvelishvili).

1977

Computational and approximate methods of optimal control. *J Math Sciences* 1979; **12** (3):310–53 (coauthor with V.B. Kolmanovskii).

Optimal structures of branching pipelines. *J Appl Math Mech* 1977;**41** (2):373–81.

Optimum acceleration of a pendulum. *Mechanics of Solids* 1977;**12** (2):13–8 (coauthor with B.N. Sokolov).

Optimal control and dynamics of oscillating systems. In: *Theoretical and Applied Mechanics. Proc 14th IUTAM Congr*. Amsterdam: North Holland; 1977: 331–41.

The method of averaging for the optimal control of non-linear oscillating systems. In: *VII Int Conf on Non-linear Oscillations*. Berlin: Akademie; 1977: Vol. I, 129–34 (coauthor with L.D. Akulenko).

The structure of optimum branching pipelines. In: *Theoretical and Applied Mechanics. Proc 3rd National Congr. Book 2*. Sofiya: Bolg Akad Nauk; 1977: 443–8.

Controlling the displacement of a weight in a vertical plane. *Mechanics of Solids* 1977;**12** (4):79–86 (coauthor with V.M. Mamalyga).

Optimal control of stochastic processes. In: *Theory of Nonlinear Operators. Constructive Aspects. Proc Int Summer School. Abh Akad Wiss Abt Math - Naturwiss Techn No. 1N*. Berlin: Akademie; 1977: 29–43.

1978

On the motion of a solid body with elastic and dissipative elements. *J Appl Math Mech* 1978;**42** (1):32–40.

Game Problems of Control and Search. Moscow: Nauka; 1978: (coauthor with A.A. Melikyan).

The motion of a rigid body containing elastic and dissipative elements. *14th Yugosl Congr on Theoretical and Applied Mechanics*. Portoroz; 1978: A1–6, 41–8.

A method for calculating the control in antagonistic situations. *USSR Comput Math Math Phys* 1978;**18** (5):21–7 (coauthor with A.I. Albul and B.N. Sokolov).

Minimax problems of control, observation and search. *Teoret Prilozh Mekhanika Sofiya* 1978;**9** (3):16–24 (coauthor with A.A. Melikyan).

Optimal Control under Random Perturbations. Moscow: Nauka; 1978. (coauthor with V.B. Kolmanovskii).

Approximation of integral functionals and numerical solution of variational problems. In: *Theory of Nonlinear Operators. Constructive Aspects. Proc Int Summer School. Abh Akad Wiss Abt Math - Naturwiss Techn No. 6N*. Berlin: Akademie; 1978: 51–9.

Optimal control of mechanical systems. In: *Modern Problems of Theoretical and Applied Mechanics. Proc 4th All-Union Congr on Theoretical and Applied Mechanics*. Kiev: Naukova Dumka; 1978: 115–28.

1979

The choice of times of observation in a linear game of approach. *Soviet J Computer and Systems Sciences* 1979;**17** (1):6–11 (coauthor with A.A. Melikyan).

Optimal control of oscillations. In: *Problems of Stability of Motion, Analytical Mechanics and Motion Control*. Novosibirsk: Nauka; 1979: 167–79.

Problems of optimization of mechanical systems. *Uspekhi Mekhaniki* 1979;**2** (1):3–36.

A method for control of stochastic systems. *Soviet J Computer and Systems Sciences* 1979;**17** (3):1–9 (coauthor with V.B. Kolmanovskiy and N.N. Moiseyev).

Some optimum configurations of branching rods. *Mechanics of Solids* 1979;**14** (3):152–8.

The effect of internal elasticity and dissipation on the motion of a solid about the centre of mass. In: *Continuum Dynamics. Mechanics of a Deformable Solid*. Novosibirsk: Inst Gidrodinamiki SO Akad Nauk SSSR; 1979: No. 41, 118–22.

Perturbed motions of a rigid body, close to the Lagrange case. *J Appl Math Mech* 1979;**43** (5):829–37 (coauthor with L.D. Akulenko and D.D. Leshchenko).

Optimal control of some oscillating systems. In: *Symp Optimization Methods - Applied Aspects*. Varna; 1979: 89–99 (coauthor with V.M. Mamalyga and B.N. Sokolov).

Asymptotic methods in some problems of optimal control. In: *Asymptotic Methods in Theory of Non-linear Oscillations. Proc All-Union Conference*. Kiev: Naukova Dumka; 1979: 239–46.

The effect of internal elastic oscillations on the motion of a rigid body. In: *Proc 8th Int Conf Nonlinear Oscillat*. Prague; 1979: Vol. 2, 1061–6.

Optimization of the work of load-handling machinery and loaders. In: *Automation of Processes of Precise Finishing and Transport-Warehouse Operations in Engineering*. Moscow: Nauka; 1979: 148–53 (coauthor with B.N. Sokolov and V.M. Mamalyga).

1980

Problems of searching for a moving object. *Soviet Math Dokl* 1980;**21** (1):339–42.

Controlled search of a moving object. *Prikl Mat Mekh* 1980;**44** (1):1–6.

Motion of a viscoelastic solid relative to the centre of mass. *Mechanics of Solids* 1980;**15** (1):17–21.

Guaranteed estimates of undetermined quantities using ellipsoids. *Dokl Akad Nauk SSSR* 1980;**251** (1):51–4.

Optimum branching structures in biomechanics. *Mech Composite Mater* 1980;**16** (2):233–8.

Control of Oscillations. Moscow: Nauka; 1980 (coauthor with L.D. Akulenko and B.N. Sokolov).

Optimal guaranteed estimates of uncertainties using ellipsoids. I–III. *Izv Akad Nauk SSSR Tekhn Kibernetika* 1980;(3):3–11;(4):3–11;(5):5–11.

Optimal and suboptimal control of oscillating dynamical systems. In: *Control Applications Nonlinear Programming*. Oxford: Pergamon; 1980: 99–107 (coauthor with V.M. Mamalyga and B.N. Sokolov).

Guaranteed ellipsoidal estimates of uncertainties in control problems. *Wiss Z Techn Hochschule Leipzig* 1980;4(6):325–9.

1981

Ellipsoidal estimates of the region of attainability of a controlled system's attainability domain. *J Appl Math Mekh* 1981;**45** (1):7–12.

Simulation of the dynamics of a manipulator with elastic elements. *Mechanics of Solids* 1981;**16** (3):111–17 (coauthor with L.D. Akulenko and S.A. Mikhailov).

Estimates of attainable sets of controlled dynamical systems. In: *Theoretical and Applied Mechanics. 4th National Congr*. Sofiya: Izd Bolg Akad Nauk; 1981: 44–9.

Motion of plane bodies with dry friction. *Mechanics of Solids* 1981;**16** (4):14-24 (coauthor with A.Yu. Ishlinskii and B.N. Sokolov).

Asymptotic methods in the theory of optimal control. *IEEE Trans Automatic Control* 1981;**AS-26** (5):993–1000 (coauthor with N.N. Moiseyev).

Dynamics of controlled motions of an elastic manipulator. *Izv Akad Nauk SSSR Tekhn Kibernetika* 1981;(5):142–52.

Optimal control of mechanical systems. In: *Advances in Theoretical and Applied Mechanics*. Moscow: Mir; 1981: 77–101.

1982

Problems of the optimization of mechanical systems. *Mashinovedeniye* 1982;(2):3–9.

Fast motion of a heavy rigid body about a fixed point in a resistive medium. *Mechanics of Solids* 1982;**17** (3):1–8 (coauthor with L.D. Akulenko and D.D. Leshchenko).

Method of successive approximations for solution of optimal control problems. *Optimal Control Applications and Methods* 1982;**3** (2):101–14 (coauthor with A.A. Lyubushin).

Ellipsoidal bounds for sets of attainability and uncertainty in control problems. *Optimal Control Applications and Methods* 1982;**3** (2):187–202.

Measurements of mechanical and geometric quantities using robotic systems. Preprint No. 197. Moscow: Inst Probl Mekh Akad Nauk SSSR; 1982. (coauthor with V.G. Gradetskii and V.B. Veshnikov).

Two-sided estimates on the attainability domains of controlled systems. *J Appl Math Mech* 1982;**46** (5):590–5 (coauthor with A.I. Ovseyevich).

Guaranteed ellipsoidal estimates of uncertainties in control problems. In: *Proc 8th Triennial World Congr IFAC*. Oxford: Pergamon; 1982: Vol. 2, 869–74.

1983

Some problems of mechanics and control for pneumatic industrial robots. In: *Proc 13th Int Symp Industrial Robots*. Chicago; 1983: Vol. 2, 13.69–13.85 (coauthor with A. Yu. Ishlinskii and V. G. Gradetskii).

Investigation of the dynamics of manipulation robots taking into account the elasticity of their structure. In: *1st Soviet-Yugosl Seminar on Robotics*. Moscow; 1983: 91–5.

The dynamics of controlled motions of systems with elastic elements. In: *Control of Distributed Systems with Moving Action. Symp Sci Proc*. Kuibyshev; 1983: 155–61.

The method of successive approximations for calculating optimal control. *Izv Akad Nauk SSSR Tekhn Kibernetika* 1983;(2):147–59 (coauthor with A.A. Lyubushin).

On equations of ellipsoids approximating reachable sets. *Probl Control and Inform Theory* 1983;12(2):97–110.

Asymptotic behavior of singular perturbations in the problem of dynamics of a rigid body with elastic and dissipative elements. *Mechanics of Solids* 1983;**18** (3):31–41 (coauthor with A.S. Shamayev).

Dynamics of systems with elastic elements of large stiffness. *Mechanics of Solids* 1983;**18** (4):99–112.

Guaranteed ellipsoidal estimates of state for dynamic systems. In: *Random Vibrations and Reliability. Proc IUTAM Symp*. Berlin: Akademie; 1983: 145–52.

Ellipsoidal estimation of the state of controlled dynamical systems. Preprint No. 224. Moscow: Inst Probl Mekh Akad Nauk SSSR; 1983 (coauthor with A.I. Ovseyevich, B.R. Klepfish and V.L. Trushchenkov).

Numerical methods of optimal control. In: *Mathematical Modelling. 8th National School. Application of Mathematics to Engineering*. Sofiya; 1983: 76–98.

A device for controlling load-lifting and transport equipment with a flexible load suspension. Inventors Cert No. 1017655. Invention Priority from 12.10.1981 (coauthor with V.G. Gradetskii, B.N. Sokolov and M. Yu. Rachkov).

1984

Investigation of the dynamics of a manipulator with elastic elements. *Mechanics of Solids* 1984;**19** (2):49–56 (coauthor with S.A. Mikhailov).

The dynamics of systems containing elastic and dissipative elements. In: *16th Yugosl Congr on Theoretical and Applied Mechanics*. Becici; 1984: A1–19, 165–72.

Evolution equations for slow variables in the theory of singularly perturbed systems. *Soviet Physics Dokl* 1984;**29** (7):541–3 (coauthor with A.S. Shamayev).

Analysis of the elastic compliance of the structure of manipulation robots. Preprint No. 231. Moscow: Inst Probl Mekh Akad Nauk SSSR; 1984 (coauthor with V.G. Gradetskii, A.A. Gukasyan, V.B. Veshnikov, K.V. Samvelyan, V.P. Stepanov and D.A. Shushko).

The equation of continuous guaranteed estimation of the state of dynamical systems. *Izv Akad Nauk SSSR Tekhn Kibernetika* 1984;(4):94–101 (coauthor with A.I. Ovseyevich and V.L. Trushchenkov).

Guaranteed estimation of attainable sets of controlled systems. In: *Stochastic Optimization. Int Conf*. Kiev; 1984: Part 2, 119–21.

Dynamics of an elastic manipulator with specified control moments or motions of the load. *Mechanics of Solids* 1984;**19** (5):17–23 (coauthor with S.A. Mikhailov).

Control of oscillations of mechanical systems. In: *9th Int Conf on Non-linear Oscillations*. Kiev: Naukova Dumka; 1984: Vol. 3, 286–90 (coauthor with L.D. Akulenko).

1985

Effect of elastic structural compliance of robots on their dynamics. *Mechanics of Solids* 1985;**20** (3):63–71 (coauthor with V.G. Gradetskii, A.A. Gukasyan and A.I. Grudev).

Optimal programmed motions of a two-link manipulator. *Soviet J Computer and Systems Sciences* 1985;**23** (5):65–73 (coauthor with V.V. Avetisyan and N.N. Bolotnik).

Dynamics of robots with elastic elements. In: *Symp on Fundamentals of Dynamics and Steering of Industrial Robots*. Berlin; 1985: Vol. I, 12–25.

Dynamics of industrial robots with elastic flexible structure. In: *Proc 15th Int Symp on Industrial Robots*. Tokyo; 1985: Vol. 1, 331–8 (coauthor with V.G. Gradetskii).

On differential games of evasion from many pursuers. *J Optimiz Theory and Appl* 1985;**46** (4):461–70 (coauthor with V.L. Zak).

Optimal control of manipulation robots. In: *A Bridge between Control Science and Technology. Proc 19th Triennial World Congr IFAC*. Oxford: Pergamon; 1985: Vol. 1, 311–5 (coauthor with L.D. Akulenko, N.N. Bolotnik and A.A. Kaplunov).

Some application problems of the industrial measuring robot system. In: *Proc Int Conf on Advanced Robotics*. Tokyo; 1985: 597–603 (coauthor with V.G. Gradetskii).

1986

Ellipsoidal state estimation of dynamic systems. In: *Stochastic Control. 2nd IFAC Symp. Preprints*; 1986: 1, 154–8 (coauthor with A.I. Ovseyevich and V.L. Trushchenkov).

Asymptotic modelling of the motion of a manipulator on a vibrating base. In: *3rd Soviet-Yugosl Symp on Robotics and Flexible Automated Plants*. Moscow; 1986: 75-80 (coauthor with B.V. Aksel'rod and V.G. Gradetskii).

Problems of Mechanics and Optimization of Robotic Motions. In: *7th CISM-IFToMM Symp on Theory and Practice of Robots and Manipulators. Preprints*. Krakow; 1986: 564–71 (coauthor with L.D. Akulenko, N.N. Bolotnik and V.G. Gradetskii).

Some problems of the mechanics of an intracapsule artificial crystalline lens. In: *Medical Biomechanics. Abstracts of Papers of Int Conf on Advances of Biomechanics in Medicine*. Riga; 1986: Vol. 1, 28–33 (coauthor with I.M. Anan'evskii, R.V. Gol'dshtein, I.N. Dashevskii, N.F. Korosteleva, N.M. Osipenko, N.A. Sushkova and V.E. Shklover).

Perturbed motion of a rigid body that are close to regular precession. *Mechanics of Solids* 1986;**21** (5):1–8 (coauthor with L.D. Akulenko and D.D. Leshchenko).

Dynamics of systems of rigid bodies with elastic elements. In: *Proc 15th Int Conf on Dynamics of Machines, Frankfurt/Oder*, 1985; 1986: Part 1, 39–54.

Guaranteed estimates of reachable sets for controlled systems. In: *Lecture Notes in Control and Information Sciences. IIASA.81. Stochastic Optimization. Proc Int Conf*. Berlin: Springer; 1986: 619–31.

Asymptotic methods in dynamics of systems with elastic and dissipative elements. In: *Proc 4th Int Conf on Boundary and Interior Layers - Computational and Asymptotic Methods*. Dublin: Boole; 1986: 15–26.

1987

Modelling of manipulator dynamics in the case of a vibrating base. *Mechanics of Solids* 1987;**22** (2):55–61 (coauthor with B.V. Aksel'rod, D. Vujic, M. Vukobratovic and V.G. Gradetskii).

Problems of the mechanics of robots with elastic elements. In: *Proc 5th Yugosl Symp on Applied Robotics and Flexible Automation*. Beograd; 1987: 40–8.

State estimation for dynamical systems by means of ellipsoids. In: *Lecture Notes in Economics and Mathematical Systems. 287. Dynamical Systems. Proc IIASA Workshop on Mathematics of Dynamical Processes*. Berlin: Springer; 1987: 95–105.

Dynamics of an anthropomorphic robot operating as part of a flexible robotic welding system. *Izv Akad Nauk SSSR Tekhn Kibernetika* 1987;(3):50–63 (coauthor with V.G. Gradetskii, V.V. Nazarov, K.V. Samvelyan and V.P. Stepanov).

Approximation of attainable sets of controlled systems. In: *Differential Controls and Applications. Proc 3rd Conf*. Russe; 1987: Part 1, 469–74.

Approximation of attainable sets using the intersections and unions of ellipsoids. *Soviet J Computer and Systems Sciences* 1988;**26** (1):128–36 (coauthor with A.A. Yangin).

Asymptotic modelling of the motion of a manipulator on a vibrating base. *Problemy Mashinostroyeniya Avtomatizatsii* 1987;(15):42–5 (coauthor with B.V. Aksel'rod and V.G. Gradetskii).

On optimal ellipsoids approximating reachable sets. *Probl Control and Inform Theory* 1987;**16** (2):125–34 (coauthor with A.I. Ovseyevich).

Algorithms of guaranteed ellipsoidal estimation and filtering for dynamical systems. Preprint No. 293. Moscow: Inst Probl Mekh Akad Nauk SSSR; 1987 (coauthor with A.I. Ovseyevich, Yu. N. Reshetnyak, V.L. Trushchenkov and A.A. Yangin).

Calculation of parameters of vibration mechanism with unbalanced-mass vibration exciters. *Mechanics of Solids* 1987;**22** (5):46–54 (coauthor with N.N. Bolotnik, B.V. Gusev, Nguen Cheung and I.E. Kholmin).

Issues of the dynamics of robots as elements of flexible automated plants. In: *Issues of Design of Flexible Automated Plants*. Moscow: Nauka; 1987: 143–51 (coauthor with V.G. Gradetskii).

Mechanics of mine robotic systems based on a mobile manipulator. Preprint No. 311. Moscow: Inst Probl Mekh Akad Nauk SSSR; 1987 (coauthor with V.G. Gradetskii, L.F. Fomin, Yu.N. Kiklevich, P.I. Kotenko, A.M. Kovalev and V.S. Yelfimov).

Problems of mechanics and optimization of robotic motions. In: *Proc 6th CISM-IFToMM Symp on Theory and Practice of Robots and Manipulators*. Paris: Kogan Page; 1987: 623–32 (coauthor with L.D. Akulenko, N.N. Bolotnik and V.G. Gradetskii).

Simulation of dynamics and optimization of robotic systems. In: *Information Control Problems in Manufacturing Technology. Proc 5th IFAC/IFIP/IMACS/IFORS Conf, Suzdal', 1986*. Oxford: Pergamon; 1987: 199–204 (coauthor with L.D. Akulenko, N.N. Bolotnik and V.G. Gradetskii).

Guaranteed estimation of the phase state of dynamical systems. In: *XII National Summer School on Applications of Mathematics to Engineering, Varna, 1986. Proceedings*. Sofiya; 1987: 100–7.

1988

Estimation of the Phase State of Dynamical Systems. *The Method of Ellipsoids*. Moscow: Nauka; 1988.

Modelling of the dynamics of assembly robots. Preprint No. 318. Moscow: Inst Probl Mekh Akad Nauk SSSR; 1988 (coauthor with V.B. Velikovich, I.M. Dvoskin, V.L. Zak, G.U. Pirumov, V.P. Stepanov and E.I. Shekhvits).

Optimal control of the electric motor of a robot with an elastic link. In: *Proc 4th Yugosl-Soviet Symp on Applied Robotics and Applied Automation*. Novi Sad; 1988: 65–72 (coauthor with N.N. Rogov).

On the construction of a bounded control in oscillatory systems. *J Appl Math Mech* 1988;**52** (4):426–33.

A robot system moving over vertical surfaces. *Soviet J Computer and Systems Sciences* 1989;**27** (3):130–142 (coauthor with A.V. Abarinov, B.V. Aksel'rod, N.N. Bolotnik, V.B. Veshnikov, A.V. Gomozov, V.G. Gradetskii, F.V. Zinov'ev, L.M. Meshman, V.S. Moskalev and M.Yu. Rachkov).

Mechanics of supporting elements of artificial intracapsular lenses. *Mechanics of Solids* 1988;**23** (4):168–73 (coauthor with I.M. Anan'evskii).

Asymptotic methods in the dynamics of systems with elastic elements. In: *Asymptotic Methods of Mathematical Physics*. Kiev: Naukova Dumka; 1988: 270–7.

Equilibrium conditions for a solid on a rough plane. *Mechanics of Solids* 1988;**23** (6):1–12.

Technical re-equipment of the moulding rooms at prefabricated reinforced concrete plants. *Improvement in the Efficiency of Working Processes and Machinery in the Building Industry*. Yaroslavl'; 1988: 33–7 (coauthor with B.V. Gusev, N.N. Bolotnik, Nguen Cheung and I.Ye. Kholmin).

Method for guaranteed state estimation of dynamic systems. In: *Proc 10th IFAC World Congr, Munich, 1987*. Oxford: Pergamon: Vol. 8, 16–22 (coauthor with A.I. Ovseyevich and V.L. Trushchenkov).

Estimation of the phase state of controlled dynamical systems. In: *Issues of the Qualitative Theory of Differential Equations*. Novosibirsk: Nauka; 1988: 266–70.

A vibration table for the moulding of articles from concrete mixes. Inventor's Certificate No. 1459927. Priority from 15.4.1987 (coauthor with N.N. Bolotnik, V.B. Gusev, I. Ye. Kholmin and P.V. Chichkov).

1989

Optimal control of the electric motor of a robot with an elastic element. *Soviet J Computer and Systems Sciences* 1989;**27** (5):39–50 (coauthor with N.N. Rogov).

Oscillations of a rigid body with a toroidal cavity filled with a viscous liquid. Preprint Pr-1547. Moscow: Inst Kosmich Issled Akad Nauk SSSR; 1989 (coauthor with M.L. Pivovarov).

Optimal control of a robot with electric drive and elastic element. *Robot Control. 2nd IFAC Symp, Karlsruhe*, 1988. Oxford: Pergamon; 1989: 231–5 (coauthor with N.N. Rogov).

On the motion of a particle over a rough rotating plane. *J Appl Math Mech* 1989;**53** (3):281–8 (coauthor with A.I. Grudev and A. Yu. Ishlinskii).

Equilibrium of a body on a rough plane. *Soviet Physics Dokl* 1989;**34** (5):702-5.

Time-optimal control for robotic manipulators. *Optimal Control Applications and Methods* 1989;**10** (4):293–311 (coauthor with L.D. Akulenko and N.N. Bolotnik).

Manipulation Robots. Dynamics, Control and Optimization. Moscow: Nauka; 1989 (coauthor with N.N. Bolotnik and V.G. Gradetskii).

1990

Evolution of rigid body motions due to dissipative torques. In: *Nonlinear Dynamics of Engineering Systems. IUTAM Symp, Stuttgart, 1989*. Berlin: Springer; 1990: 51–7.

Optimization of manipulation robot control. *Soviet J Computer and Systems Sciences* 1990;**28** (5):127–69 (coauthor with N.N. Bolotnik).

On mechanics of climbing robot. In: *Proc 17th Int Symp on Automation and Robots Construction*. Bristol; 1990: Vol. 1, 9–15.

Oscillations of a rigid body with a toroidal cavity filled with a viscous liquid. *J Appl Math Mech* 1990;**54** (2):164–8 (coauthor with M.L. Pivovarov).

The equilibrium of a body on a plane in the presence of dry friction. In: *Theoretical and Applied Mechanics. 6th National Congr, Varna, 1989. Proceedings. Book 1*. Sofiya; 1990: 153–6.

Models and optimal control of robotic systems. In: *Lecture Notes in Control and Information Sciences. 143. System Modelling and Optimization. Proc 14th IFIP Conf, Leipzig, 1989*. Berlin: Springer; 1990:1–22.

Guaranteed estimation of the phase state of dynamical systems by the method of ellipsoids. In: *Fundamental Investigations of the Reliability and Quality of Machines*. Moscow: Otdeleniye Problem Mashinovedeniya, Mekhaniki i Protsessov Upravleniya Akad Nauk SSSR; 1990: 105–24.

Decomposition of the control of a dynamical system. *Dokl. Akad Nauk SSSR* 1990;**314** (4):801–5.

Decomposition and suboptimal control in dynamical systems. *J Appl Math Mech* 1990;**54** (6):727–34.

Decomposition and synthesis of control in dynamical systems. *Soviet J Computer and Systems Sciences* 1991;**29** (5):126–44.

On the mechanics of a climbing robot. *Mechatronic Systems Engineering* 1990;**1**: 219–24.

1991

Constrained controls in linear oscillating systems. In: *Lecture Notes in Control and Information Sciences. INRIA. 144. Analysis and Optimization of Systems. Proc 9th Intern Conf, Antibes*, 1990. Berlin: Springer; 1991: 580–9.

Asymptotic analysis for dynamics of rigid body containing elastic elements and viscous fluid. In: *Dynamical Problems of Rigid-Elastic Systems and Structures. IUTAM Symp, Moscow, 1990*. Berlin: Springer; 1991: 55–64.

Mobile systems with vertical-displacement robots. *J Computer and Systems Sciences Intern* 1993;**31** (1): 126–42 (coauthor with V.G. Gradetskii, M. Yu. Rachkov, Yu. G. Sizov and S.V. Ul'yanov).

Control synthesis for a system with non-linear resistance. *J Appl Math Mech* 1991;**55** (6):759–71.

Modelling and control for manipulative robots with elastic elements. In: *Proc 18th CISM-IFToMM Symp on Theory and Practice of Robots and Manipulators, Krakow, 1990*. Warsaw; 1991: 116–23 (coauthor with G.U. Pirumov and N.N. Rogov).

1992

Control synthesis for a non-linear dynamical system. *J Appl Math Mech* 1992;**56** (2):157–66.

Bounded controls in distributed-parameter systems. *J Appl Math Mech* 1992;**56** (5):707–23.

Constrained control of a fourth-order linear system. *J Computer and Systems Sciences Inter* 1994;**32** (4):108–15 (coauthor with I.S. Dobrynina).

1993

Decomposition and suboptimal control in dynamic systems. *J Computer and Systems Sciences Intern* 1994;**32** (2):164–70.

Decomposition and feedback control of uncertain dynamical systems. In: *Proc 2nd Eur Control Conf*. Groningen; 1993: Vol. 2, 810–13.

Method of calculating the effective elastic moduli of periodic rod structures. *Mechanics of Solids* 1993;**28** (3):173–8 (coauthor with V.A. Korneyev, S.A. Mikhailov and A.S. Shamayev).

Decomposition and suboptimal control in dynamic systems. *Optimal Control Applications and Methods* 1993;**14** (2):125–43.

Decomposition and feedback control of nonlinear dynamic systems. *Optimal Control*. Basel: Birkhäuser; 1993: 163–71.

Multielement universal walking robot: some problems of dynamics. *Mechanics of Solids* 1993;**28** (4):85–98 (coauthor with N.N. Bolotnik, V.B. Veshnikov and V.G. Gradetskii).

The decomposition of controlled dynamic systems. In: *Advances in Nonlinear Dynamics and Control*. Boston: Birkhuser; 1993: 1–40.

Decoupling and suboptimal control for robots. In: *Proc 9th CISM-IFToMM Symp on Theory and Practice of Robots and Manipulators, Udine, 1992*. London: Springer; 1993: 179–85.

1994

State Estimation for Dynamic Systems. Boca Raton: CRC Press; 1994.

Computer modelling of the control of the motion of a system of connected rigid bodies. *Izv Ross Akad Nauk Tekhn Kibernetika* 1994;(1):167–80 (coauthor with I.S. Dobrynina and I.I. Karpov).

Optimization in control of robots. In: *Computational Optimal Control*. Basel: Birkhäuser; 1994: 19–28.

The synthesis of constrained control for distributed systems. *J Computer and Systems Sciences Intern* 1995;**33** (5):131–40.

Feedback control of uncertain nonlinear dynamic systems. In: *Modeling Techniques for Uncertain Systems. Proc Conf, Sopron, 1992*. Boston: Birkhäuser; 1994: 173–84.

Manipulation Robots. Dynamics, Control and Optimization. Boca Raton: CRC Press; 1994 (coauthor with N.N. Bolotnik and V.G. Gradetskii).

1995

Reconstructing trajectories from measurement data. *J Appl Math Mech* 1995;**59** (1):57–64 (coauthor with A.V. Kirgetov).

Optimal control of robotic systems. In: *Proc 21st Yugosl Congr on Theoretical and Applied Mechanics. Invited Lectures*. Nis; 1995: 145–54.

Control of nonlinear dynamical systems subject to uncertain disturbances. In: *Proc 21st Yugosl Congr on Theoretical and Applied Mechanics. Invited Lectures*. Nis; 1995: 216–20.

Use of the decomposition method in controlling a mechanical system. *J Computer and Systems Sciences Intern* 1996;**34** (5):138–49 (coauthor with I.M. Anan'evskii and I.S. Dobrynina).

Dynamics of retrieval of a space tethered system. *J Appl Math Mech* 1995;**59** (2):165–73.

Multilink mobile robot for motion over arbitrarily inclined surfaces. In: *Proc 1st ECPD Int Conf on Advances in Robotics and Intelligent Automation*. Athens; 1995: 470–5 (coauthor with V.G. Gradetskii, N.N. Bolotnik and V.B. Veshnikov).

Optimal two-sided ellipsoidal state estimation in dynamical systems. In: *Proc 3rd Eur Control Conf*. Rome; 1995: Vol. 2, 961–5 (coauthor with A.I. Ovseyevich and A.M. Shmatkov).

Nonlinear feedback design in Lagrangian systems. In: *Proc 3rd Eur Control Conf*. Rome; 1995: Vol. 2, 1098–1102.

The time-optimal control problem under mixed constraints. *Izv Ross Akad Nauk Teoriya Sistemy Upravleniya* 1995;(4):103–13.

Parameter optimization for a tube-crawling robot. *Mechanics of Solids* 1995;**30** (6):23–35 (coauthor with N.N. Bolotnik).

Construction of a control when there are mixed constraints. *J Computer and Systems Sciences Intern* 1996;**34** (6):60–76.

Bounded control in elastic systems. In: *Trends in Applications of Mathematics to Mechanics. Proc Symp, Lisbon, 1994*. New York: Longman; 1995: 261–6.

Decomposition and feedback control in non-linear dynamical systems. In: *Proc Mat Inst im V. A. Steklova. Vol. 211. Optimal Control and Differential Equations*. Moscow: Nauka/Fizmatlit; 1995: 457–72.

1996

Constrained control in a mechanical system with two degrees of freedom. In: *Proc IUTAM Symp on Optimization of Mechanical Systems, Stuttgart, 1995*. Dordrecht: Kluwer; 1996: 57–64 (coauthor with I.S. Dobrynina).

Optimization of structural parameters and gaits of a pipe-crawling robot. In: *Proc IUTAM Symp on Optimization of Mechanical Systems, Stuttgart, 1995*. Dordrecht: Kluwer; 1996: 231–8 (coauthor with F. Pfeiffer, T. Rossmann and N.N. Bolotnik).

Decomposition and suboptimal control in dynamical systems. *Systems Modelling and Optimization*. In: *Proc 17th IFIP TC7 Conf, Prague, 1995*. London: Chapman and Hall; 1996: 13–23.

Control of nonlinear dynamical systems. In: *Proc 2nd Eur Nonlinear Oscillations Conf*. Prague; 1996: Vol. 1, 15–22.

Modeling and optimization of motion of a tube-crawling robot. *Mechanics of Solids* 1996;**31** (3):151–63 (coauthor with N.N. Bolotnik and G.V. Kostin).

Mechanics of climbing and crawling robots. In: *Proc 2nd ECPD Int Conf on Advanced Robotics, Intelligent Automation and Active Systems*. Vienna; 1996: 40–4.

Estimation of the attainability sets of linear systems with an indeterminate matrix. *Dokl Math* 1996;**54** (1):634–6.

Control of elastic systems by bounded distributed forces. *Applied Math Comput* 1996;**78** (2):103–110.

Ellipsoidal approximation of attainability sets of a linear system with an indeterminate matrix. *J Appl Math Mech* 1996;**60** (6):921–31.

Optimization of walking robot parameters. *ZAMM* 1996;**7** 6(Suppl. 3):275–8 (coauthor with N.N. Bolotnik and G.V. Kostin).

Suboptimal feedback control of manipulation robots. *ZAMM* 1996;**76** (Suppl. 3):279–82.

1997

Design of control under mixed constraints. In: *Interaction Between Dynamics and Control in Advanced Mechanical Systems. Proc IUTAM Symp, Eindhoven, 1996*. Dordrecht: Kluwer; 1997: 67–74.

Modelling and optimization of the tube-crawling robot. In: *Theory and Practice of Robots and Manipulators. Proc 11th CISM-IFToMM Symp, Udine, 1996*. Vienna: Springer; 1997: 21–6 (coauthor with N.N. Bolotnik).

Bounded distributed controls in elastic systems. In: *Proc 1st Int Conf on Control of Oscillations and Chaos*. St Petersburg; 1997: Vol. 1, 25–8.

Modelling and optimization of walking robots. In: *Proc 3rd ECPD Int Conf on Advanced Robotics, Intelligent Automation and Active Systems*. Bremen; 1997: 35–46 (coauthor with N.N. Bolotnik and G.V. Kostin).

Synthesis of time-optimal control in a third-order system. *Dokl Math* 1997;**55** (3):467-70 (coauthor with A.M. Shmatkov).

Decomposition and synthesis of control in a nonlinear dynamic system. In: *Proc Int Conf on Informatics and Control*. St Petersburg; 1997: 45–52 (coauthor with S.A. Reshmin).

Bounds on reachable sets of dynamical systems with uncertain matrices. *J Brazilian Soc Mech Sci* 1997;**19** (2):280–90.

On equilibrium and dynamics of a rigid body in the presence of dry friction. *Nonlinear Analysis. Theory, Methods and Applications*. In: *Proc 2nd World Congr on Nonlinear Analysis, Athens, 1996*. Oxford: Elsevier; 1997: Vol. 30, No. 7, 4509–16.

Time-optimal control in a third-order system. *J Appl Math Mech* 1997;**61** (5):699–707 (coauthor with A.M. Shmatkov).

1998

Synthesis of a control in a non-linear dynamical system based on decomposition. *J Appl Math Mech* 1998;**62** (1):115–22 (coauthor with S.A. Reshmin).

Modeling and optimization of wall-climbing and tube-crawling robot In: *Proc Eur Mechanics Colloquium Euromech 375 on Biology and Technology of Walking*. Munich; 1998: 165–72 (coauthor with N.N. Bolotnik and G.V. Kostin).

Dynamic programming. *Sorosovskii Obrazovatel'nyi Zh* 1998;(2):139–44.

Synthesis of time-optimal control in a third-order system. In: *Nonsmooth and Discontinuous Problems in Control and Optimization. Proc Int Workshop*. Chelyabinsk; 1998: 61–3 (coauthor with A.M. Shmatkov).

Decomposition of control for nonlinear Lagrangian systems. In: *Preprints of 4th IFAC Nonlinear Control Systems Design Symp*. Enschede;1998: Vol. 1, 209–14 (coauthor with S.A. Reshmin).

Motion of a tube-crawling robot in a toroidal tube. In: *Proc 4th ECPD Int Conf on Advanced Robotics, Intelligent Automation and Active Systems*. Moscow; 1998: 96–101 (coauthor with N.N. Bolotnik and G.V. Kostin).

Decomposition of control for robotic manipulators. In: *Proc 4th ECPD Int Conf on Advanced Robotics, Intelligent Automation and Active Systems*. Moscow; 1998: 184–9 (coauthor with S.A. Reshmin).

Optimal branching structures. *Sorosovskii Obrazovatel'nyi Zh* 1998;(3):123–7.

Motion of a heavy chain over a rough surface. *Dokl Physics* 1998;**43** (7):457–9.

Motion of a tube-crawling robet in a toroidal pipe. *Mechanics of solids* 1998;**33** (4):73–86 (coauthor with N.N. Bolotnik and G.V. Kostin).

Optimal structure of branching pipelines. In: *Proc Sci Seminar under the Direction of Acad KV Frolov*. Moscow: Inst Mashinostroyeniya im AA Blagonravova Ross Akad Nauk; 1998: 71–4.

1999

The dynamics of bodies in the presence of dry friction. In: *Mechanics and Navigation. Proc Scientific Session devoted to Acad A Yu Ishlinskii's, 85th Birthday, Moscow, 1998*. St Petersburg; 1999: 48–51.

Control of dynamical systems subject to mixed constraints. In: *Dynamics and Control*. Amsterdam: Gordon and Breach; 1999: 1–8.

Bounds on reachable sets of dynamical systems with perturbed matrices. In: *Proc 6th St Petersburg Symp on Adaptive Systems*. St Petersburg; 1999: Vol. 1, 41–6 (coauthor with D. Ya. Rokityanskii).

Optimal interaction of a two-member linkage with a rough surface. In: *EUROMECH Colloq 404 Advances in Computational Multibody Dynamics*. Lisbon; 1999: 149–64 (coauthor with N.N. Bolotnik, S.A. Kumakshev and F. Pfeiffer).

Static analysis of a two-member linkage interacting with a given surface. *Arch Appl Mech* 1999;**69** (7):429–42 (coauthor with N.N. Bolotnik, S.A. Kumakshev and F. Pfeiffer).

What is ellipsoidal modelling and how to use it for control and state estimation. In: *Whys and Hows in Uncertainty Modelling: Probability, Fuzziness and Anti-Optimization*. Vienna: Springer; 1999: 127–88.

Control of systems with one degree of freedom under constraints on the controlling force and the rate of its change. *Dokl Math* 1999;**60** (2):309–11.

Motion of a linkage over a horizontal plane. In: Proc *Int Workshop on Micro Robots, Micro Machines and Systems*. Moscow; 1999:61–8.

Control of nonlinear dynamical systems subjected to uncertain disturbances. In: *Complex Dynamical Systems with Incomplete Information. Proc 10th Workshop on Dynamics and Control, Lambrecht, 1998*. Aachen: Shaker; 1999:60–72.

Control of a system with one degree of freedom under complex restrictions. *J Appl Math Mech* 1999;**63** (5):669–76.

Control algorithm for a linear system with complex constraints. *J Computer and Systems Sciences Intern* 1999;**38** (6):880–4 (coauthor with A.S. Smyshlyayev).

Finding prokaryotic genes by the "frame-by-frame" algorithm: targeting gene starts and overlapping genes. *Bioinformatics* 1999;**15** (11):874–86 (coauthor with A.M. Shmatkov, A.A. Melikyan and M. Borodovskii).

2000

The motion of a flat linkage over a horizontal plane. *Dokl Phys* 2000;**45** (1):42–5.

Ellipsoidal bounds on reachable sets of dynamical systems with matrices subject to uncertain perturbations. *J Optimiz Theory and Appl* 2000;**104** (1):1–19 (coauthor with D. Ya. Rokityanskii).

Application of a hidden Markov model and dynamic programming for gene recognition in DNAS of bacteria and viruses. *J Computer and Systems Sciences Intern* 2000;**39** (1):155–61 (coauthor with M.Yu. Borodovskii, A.A. Melikyan and A.M. Shmatkov).

Ellipsoidal state estimation of perturbed linear systems in the presence of observation errors. In: *3rd MathMod IMACS Symp on Mathematical Modelling*. Vienna; 2000: 363–6 (coauthor with A.N. Kinev and D. Ya. Rokityanskii).

On modelling of controls and uncertain disturbances in dynamical systems. In: *3rd MathMod IMACS Symp on Mathematical Modelling*. Vienna; 2000: 367–70.

The motion of a multilink system along a horizontal plane. *J Appl Math Mech* 2000;**64** (1):5–15.

Control algorithm for a linear dynamic system subjected to complex constraints. In: *Proc 2nd Int Conf on Control of Oscillations and Chaos*. St Petersburg; 2000: Vol. 2, 241–4 (coauthor with A.S. Smyshlyayev).

Snake-like motions of multibody systems over a rough plane. In: *Proc 2nd Int Conf on Control of Oscillations and Chaos*; 2000: Vol. 2, 321–6.

The wave-like motion of a multilink system on a horizontal plane. *J Appl Math Mech* 2000;**64** (4):497–508.

Control of oscillations in systems with many degrees of freedom. In: *Proc IUTAM Symp on Recent Developments in Non-linear Oscillations of Mechanical Systems, Hanoi, 1999*. Dordrecht: Kluwer; 2000: 45–54.

Dynamics and control of snake-like locomotions. *Stability and Control: Theory and Appl* 2000;**3** (3):244–52.

Control of the motion of multilink systems over a rough plane. In: *Proc Inst Mat Mekh Yekaterinburg* 2000;**6** (1, 2):277–87.

Useful Model Cert No. 17032. Vehicle. Priority from 14.11.2000 (coauthor with V.G. Gradetskii, L.N. Kravchuk, G.V. Samokhvalov and A.S. Smyshlyayev).

Useful Model Cert No. 17033. Vehicle. Priority from 14.11.2000 (coauthor with V.G. Gradetskii, L.N. Kravchuk, G.V. Samokhvalov and A.S. Smyshlyayev).

2001

The motion of a three-link system along a plane. *J Appl Math Mech* 2001;**65** (1):13–8.

Simulation and optimization of regular motions of a tube-crawling robot. *Multibody System Dynamics* 2001;**5** (2):159–84 (coauthor with F. Pfeiffer, T. Rossmann, N.N. Bolotnik and G.V. Kostin).

Optimization of the motion of multilink robots on a horizontal plane. *J Computer and Systems Sciences Intern* 2001;**40** (2):340–8 (coauthor with A.S. Smyshlyayev).

The motion of multilink systems over a horizontal plane. *Problemy Nelineinogo Analiza v Inzhenernykh Sistemakh* 2001;**7** (Iss. 1 (13)): 1–10.

Controllable motions of a two-link mechanism along a horizontal plane. *J Appl Math Mech* 2001;**65** (4):565–77.

Decomposing algorithms for the motion control of nonlinear dynamic systems. *J Computer and Systems Sciences Intern* 2001;**40** (4):514–30 (coauthor with P.D. Krut'ko).

Regular motion of a tube-crawling robot in a curvilinear tube. In: *Proc 4th Int Conf on Climbing and Walking Robots CLAWAR 2001*. Bury St Edmunds/London: Professional Engineering Publishing Limited; 2001: 547–54 (coauthor with N.N. Bolotnik, G.V. Kostin and F. Pfeiffer).

2002

The optimum rectilinear motion of a two-mass system. *J Appl Math Mech* 2002;**66** (1):1–7.

Ellipsoidal bounds for the phase state of linear systems with parametric perturbations and an uncertain observation matrix. *J Computer and Systems Sciences Intern* 2002;**41** (1):1–9 (coauthor with A.N. Kinev and D. Ya. Rokityanskii).

Ellipsoidal state estimation for systems with additive and parametric uncertainties. In: *Nonlinear Control Systems 2001. Proc 5th IFAC Symp*. St Petersburg; 2002: Vol. 2, 565–70.

Optimization of controlled motions for multilink mechanisms. In: *Nonlinear Control Systems 2001. Proc 5th IFAC Symp*. St Petersburg; 2002: Vol. 3, 1141–6 (coauthor with A.S. Smyshlyayev).

The equilibrium conditions of a rod on a rough plane. *J Appl Math Mech* 2002;**66** (2):165–70 (coauthor with A.S. Smyshlyayev).

Optimal ellipsoidal estimation for dynamical systems subjected to uncertain perturbations. *Kibernetika Sistemnyi Analiz* 2002;(2): 85–95.

Minimax control for one of systems under disturbances. *Dokl Math* 2002;**65** (4):310–3.

Modelling and simulation of snake-like locomotions. In: *Applications of Mathematics in Engineering and Economics. Proc 27th Summer School Sozopol'01*. Sofiya: Heron Press; 2002: 29–39.

Regular motion of a tube-crawling robot in a curved tube. *Mech Structures and Machines* 2002;**30** (4):431–62 (coauthor with N.N. Bolotnik, G.V. Kostin and F. Pfeiffer).

2003

Some properties of optimal ellipsoids approximating reachability sets. *Dokl Math* 2003;**67** (1):123–6 (coauthor with A.I. Ovseyevich).

Snake-like locomotions of multilink mechanisms. *J Vibrat and Control* 2003;**9** (1–2):237–56.

New types of motions for mobile microrobots. In: *Proc Workshop on Micro Robots, Micro Machines and Micro Systems*. Moscow: Inst Probl Mech; 2003: 63–72 (coauthor with N.N. Bolotnik and T.Yu. Figurina).

Snake-like locomotions of multilink systems. In: *Virtual Nonlinear Multibody Systems*. Dordrecht: Kluwer; 2003: 343–62.

Ellipsoidal bounds on reachable sets: overview and new results. In: *IFAC Workshop on Modelling and Analysis of Logic Controlled Dynamic Systems*. Irkutsk; 2003: 25–32 (coauthor with A.I. Ovseyevich).

Motion of multilink systems over a plane. In: *Problems of Mechanics. Collection of Papers Marking the 90th Birthday of A. Yu. Ishlinskii*. Moscow: Fizmatlit; 2003: 783–802.

Patent No. 2196069. A vehicle. Priority from 17.1.2001 (coauthor with G.V. Samokhvalov and A.S. Smyshlyayev).

2004

Properties of the optimal ellipsoids approximating the reachable sets of uncertain systems. *J Optimiz Theory and Appl* 2004;**120** (2):223–46 (coauthor with A.I. Ovseyevich).

Optimal control for a class of systems subjected to disturbances. In: *NOLCOS 2004. 6th IFAC Symp on Nonlinear Control Systems, Stuttgart. Preprints*; 2004: Vol. 2, 693–7.

Optimal control for a class of systems subjected to disturbances. *J Appl Math Mech* 2004;**68** (4):503–10.

Properties of optimal ellipsoids approximating attainable sets for systems with uncertainties. *J Computer and Systems Sciences Intern* 2004;**43** (4):499–509 (coauthor with A.I. Ovseyevich).

Patent No. 2231463. A vehicle. Priority from 10.4.2002 (coauthor with V.G. Gradetskii, L.N. Kravchuk and G.V. Samokhvalov).

2005

Simulation and optimization of crawling robots. In: *Modelling, Simulation and Optimization of Complex Processes. Proc Int Conf on High Performance Sci Comput, Hanoi, 2003*. Heidelberg: Springer; 2005: 85–104.

Modelling of snake-like locomotions. In: *Modeling, Simulation and Optimization of Complex Processes. Proc Int Conf on High Performance Sci Comput, Hanoi, 2003*. Heidelberg: Springer; 2005: 105–114.

Controlled motions of multibody systems along a plane. In: *Proc IUTAM Symp on Chaotic Dynamics and Control of Systems and Processes in Mechanics, Rome, 2003*. Dordrecht: Springer; 2005: 397–406.

A comparison of interval and ellipsoidal error bounds for vector operations. *Dokl Math* 2005;**71** (1):127–30 (coauthor with A.I. Ovseyevich and Yu. V. Taraban'ko).

Bringing a non-linear manoeuvring object to the optimal position in the shortest time. *J Appl Math Mech* 2005;**69** (2):163–72 (coauthor with Yu. N. Zhelnin, A.A. Melikyan and A. Ye. Utemov).

Modelling of snake-like locomotion. *Appl Math and Comput* 2005;**164** (2):415–34.

Group-invariant synthesis of optimal control in a third-order system. In: *Modelling and Control of Autonomous Decision Support Based Systems. Proc 13th Int Workshop on Dynamics and Control, Wiesensteig*. Aachen: Shaker; 2005: 17–24 (coauthor with A.M. Shmatkov).

Properties of optimal ellipsoids approximating reachable sets of uncertain systems. *Mathematical and Computer Modelling of Dynamical Systems* 2005;**11** (2):135–47.

Dynamics of snake-like robots. *Mobile Robots and Mechatronic Systems*. In: *Proc Scientific School Conf*. Moscow: Izd MGU; 2005: Part 1, 15–30 (coauthor with S.A. Bashkirov and N.A. Sobolev).

Vibration-driven robots. In: *Proc Workshop on Adaptive and Intelligent Robots: Present and Future*. Moscow: Inst Probl Mech; 2005: Vol. 1, 26–31 (coauthor with N.N. Bolotnik, S.F. Yatsun and I. Zeidis).

On the motion of a body containing a movable internal mass. *Dokl Physics* 2005;**50** (11):593–7.

Experimental study of snake-like locomotion of a three-link mechanism. In: *Proc IUTAM Symp on Vibration Control of Nonlinear Mechanisms and Structures, Munich*. Dordrecht: Springer; 2005: 141–50 (coauthor with F. Pfeiffer and N.A. Sobolev).

Ellipsoidal state estimation for dynamical systems. *Nonlinear Analysis* 2005;**63** (5–7):872–879.

Minimax control for a class of linear systems subject to disturbances. *J Optimiz Theory and Appl* 2005;**127** (3):535–48.

2006

Methods of Controlling Non-linear Mechanical Systems. Moscow: Fizmatlit; 2006 (coauthor with I.M. Anan'evskii and S.A. Reshmin).

Comparison of interval and ellipsoidal bounds for the errors of vector operations. In: *Lecture Notes in Computer Science. Vol. 3743. Large-scale Scientific Computing. 5th Int Conf LSSC 2005, Sozopol. Revised Papers*; 2006: 289–96 (coauthor with A.I. Ovseyevich and Yu. V. Taraban'ko).

Optimal motions of a body controlled by a moving internal mass. In: *Theory of Control and Theory of Generalized Solutions of Hamilton-Jacobi Equations. Proc Int Seminar*. Yekaterinburg: Izd Ural Univ; 2006: Vol. 1, 61–72.

Optimization of the motion in a resistive medium of a body with a moving internal mass. *Tr Inst Mat Mekh UrO Ross Akad Nauk* 2006;**12** (1):242–8.

Time-optimal control of an inverted pendulum in the feedback form. *J Computer and Systems Sciences Intern* 2006;**45** (3)383–94 (coauthor with S.A. Reshmin).

Optimal control for a class of uncertain systems. In: *Lecture Notes in Economics and Mathematical Systems. 581. Coping with Uncertainty. Modelling and Policy Issues*. Berlin: Springer; 2006: 171–83.

Motion generation of the Capsubot using internal force and static friction. In: *Proc 45th IEEE Conf on Decision and Control*. San Diego; 2006: 6575–80 (coauthor with H. Li and K. Furuta).

Analysis and optimization of the motion of a body controlled by means of a movable mass. *J Appl Math Mech* 2006;**70** (6):819–42.

2007

Time-optimal control synthesis for a non-linear pendulum. *J Computer and Systems Sciences Intern* 2007;**46** (1):9–18 (coauthor with S.A. Reshmin).

Time-optimal swing-up feedback control of a pendulum. *Nonlinear Dynamics* 2007;**47** (1):65–73 (coauthor with S.A. Reshmin).

Optimal motions of a body controlled by an internal moving mass. *Int J Tomography and Statistics* 2007;**7** (F07):8–12.

Optimal control of the motion of bodies with movable internal masses in a resistive medium. In: *9th Int Chetayev Conf on Analytical Mechanics, Stability and Motion Control*. Irkutsk; 2007: Vol. 1, 247-65 (coauthor with N.N. Bolotnik and T. Yu. Figurina).

Time-optimal feedback control in swinging up and damping problems for a non-linear pendulum. In: *9th Int Chetayev Conf on Analytical Mechanics, Stability and Motion Control*. Irkutsk; 2007: Vol. 3, 179–96 (coauthor with S.A. Reshmin).

Dynamics of a body controlled by internal motions. In: *Proc IUTAM Symp on Dynamics and Control of Nonlinear Systems with Uncertainty, Nanjing, 2006*. Dordrecht: Springer; 2007: 227–36.

2008

On the optimal motion of a body with an internal mass in a resistive medium. *J Vibration and Control* 2008;**14** (1–2):197–08.

Optimal periodic motions of a two-mass system in a resistive medium. *J Appl Math Mech* 2008;**72** (2).

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