CELEBRATING JUBILEES

BIRTHDAY CONGRATULATIONS ON THE 80TH BIRTHDAY OF ACADEMICIAN FELIX LEONIDOVICH CHERNOUSKO

Academician Felix Leonidovich Chernousko, a prominent scientist in the fields of mechanics, control theory and applied mathematics, Editor-in-Chief of the *Journal of Applied Mathematics and Mechanics*, Deputy Editor-in-Chief of the *Journal of Computer and Systems Sciences International* celebrateD his 80th birthday on May 16, 2018.

Felix Leonidovich Chernousko is an Academician of Russian Academy of Sciences and a Foreign Academician of the Serbian Academy of Sciences and Arts. He is also a Honour Member of the Serbian Society of Mechanics.

SCIENTIFIC RESULTS

The range of his scientific interests and achievements is extremely broad; it covers the dynamics of rigid bodies with cavities filled with fluid, the theory of optimal control, differential games, oscillation theory, asymptotic methods of nonlinear mechanics, the theory of the estimation of the phase state of dynamical systems, numerical methods of the calculus of variations and optimal control, and robotics. In these fields he obtained fundamental results that have been internationally recognized. He is the author and coauthor of more than 450 scientific publications, including 14 monographs.

In the 1960s, as a young scientist, Chernousko performed a large series of investigations in the dynamics of rigid bodies with cavities filled with fluid. Using the classical methods of separation of motions, he studied the evolution of angular motions of a rigid body, depending on the shape of the cavity, the degree of filling, and the viscosity of the fluid. For these investigations, Chernousko was quickly recognized as a talented scientist in the field of mechanics. His results had great importance in designing spacecraft that were being developed at that time with extreme intensity. For these studies, he was awarded the Lenin Komsomol Prize (1971).

Chernousko has made a considerable contribution to the development of the optimal control theory. 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 also developed the method of local variations for the numerical solution of variational problems of mechanics and control.

He proposed and developed an effective method for the approximate analytical solution of optimal control problems for nonlinear dynamical systems with a rapidly rotating phase. It was the first method in which Pontryagin's maximum principle was combined with the Krylov-Bogolyubov 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.

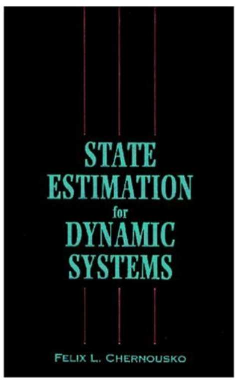
A number of fundamental results in the theory of control and observation when there is incomplete information or in conflict situations are due to this man. He was the first to state and solve the pursuit differential game with delayed information, which is significant for a number of situations occurring in practice. He investigated 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, a pursuer can catch and evader in the same amount of time as would have been the case for continuous observation. He proposed a solution for the problem of evasion of one object from a group of pursuers. He constructed the evasion strategy and gave a lower estimate for the minimal distance between the evader and the pursuers. He posed and solved the problem of searching 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. He stated and solved an optimization problem for the observation process with a constrained total duration of the observations, as well as a self-similar problem of optimal correction of the motion subject to random disturbances.

These pioneering works initiated numerous studies of control processes in stochastic systems. He developed an efficient approach to the construction of feedback controls for nonlinear mechanical systems governed by Lagrange 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 multilink robotic 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 nonlinear 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 nonlinear systems of differential equations. Chernousko has studied the properties of these systems and has 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 two-sided estimates to be obtained. Among these problems are those of controllability, optimal control, estimation of the influence of disturbances on the motion of mechanical systems, differential games, and

guaranteed filtering of observation results. Chernousko's studies in 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 scientific foundation of robotics. Combining asymptotic and numerical methods of nonlinear mechanics, he developed an efficient approach to simulating the dynamics of multilink manipulators with elastically compliant links and joints. This approach was utilized when investigating the influence of elastic compliance on the positioning accuracy for universal industrial robots and a number of special robotic systems.
He introduced the fundamental concept of guaranteed equilibrium for a rigid body in contact with a rigid surface in the presence of dry friction, and he obtained the conditions for such an equilibrium in terms of the parameters that characterize the contact area, 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).



Serbian Congress of Mechanics 2017

Felix Leonidovich Chernousko made a considerable contribution to developing the theory of guaranteed estimation and constructed optimal (in terms of volume) bilateral (external and internal) estimates for the attainable sets of controlled systems. These studies, which he began in 1980, resulted in a monograph in which he presented the theory of the method of ellipsoids for the optimal evaluation of the attainable sets of discrete-time and continuous-time systems and generalized this theory to non-linear systems and to the case of several ellipsoids used to approximate the attainable set. He estimates obtained reduce the construction of external and internal ellipsoidal approximations of the attainable sets of controlled systems to the solution of initial-value problems for a special sort of non-linear systems of differential equations. He investigated the properties of these equations and gave their solution in a number of cases. The ellipsoidal estimates suggested for the attainable sets enable one to construct approximate solutions and bilateral estimates in a number of important problems of control and estimation, including those of controllability and optimal control, the evaluation of the influence of perturbations on the motion of mechanical systems, differential games, and the guaranteed filtering of the results of observations. His research on the method of ellipsoids has been widely recognized both in Russia and abroad. His publications on this topic are frequently cited and used in theoretical and applied investigations.

He calculated the optimal parameters for the walks of a unique tube-crawling robot created 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 propulsion,

due to the change in the robot's configuration or the motion of internal masses. This concept can be utilized for hermetic mini- and microrobots that have no components and are suitable for engineering and medical diagnostics.

PUBLICATIONS AND UNIVERSITY WORK

He successfully combines his research and pedagogical activities. For more than 50 years he has taught at the Moscow Institute of Physics and Technology, he supervises the research work of undergraduate and graduate students, and he heads the Chair of Mechanics and Control Processes. He has created a leading scientific school in Russia in the field of control theory and mechanics . Sixteen of his former students have received Doctor of Sciences degrees and more than 30 have received Candidates of Sciences degrees.

Felix Leonidovich Chernousko is the author of 14 monographs and more than 450 scientific papers. His publications are distinguished by the scientific and practical topicality of the problems being solved, the rigor of his analysis, the clarity of the formulation, and the brilliant style of presentation. Throughout his life in science Felix Leonidovich Chenousko has fruitfully combined research and teaching activity. He lectures at the Moscow Institute of Physics and Technology and supervises the research work of undergraduate and graduate students. He founded a scientific school in control theory and the mechanics of controlled systems, which is a leading one in Russia.

ORGANIZATION WORK

Chernousko conducts a large amount of organizational research work. For 39 years he was the Head of the Laboratory of Control for 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.
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; Deputy Chairman of the Russian National Committee on Theoretical and Applied Mechanics.

He is a member of the editorial boards of leading Russian and international journals in the field of mechanics and control theory. He does a considerable amount of work on organizing national and international scientific conferences. He was the initiator of All-Union conferences on optimal control in mechanical systems. These conferences have been regularly held for many years, being a representative forum for theorists and engineers in control. His achievements in science have been recognized in Russia and abroad.
Felix Chernousko is a full member of the Russian Academy of Sciences and a number of foreign academies. He was awarded the Lenin Komsomol Prize, the State Prize of the USSR, and the State Prize of the Russian Federation in the field of science and technology. He is a recipient of the Koerber Prize for the development of European science and the Humboldt Prize (Germany). His colleagues and students cordially congratulate him on his birthday and wish him health, long life, and fruitful creative work in science.

At the Serbian Conges of Mechanics 2017 At the Serbian Academy of Sciences and Arts 2017

SHORTH BIOGRAPHY

F.L.Chernousko was born in St. Petersburg in 1938. In 1961 he graduated from the Moscow Institute of Physics and Technology as an Engineer-Physicist. At the same Institute, he got his Candidate of Sciences (Ph. D., 1964) and Doctor of Sciences (1969) degrees. From 1963 till 1968, F.L.Chernousko worked as a researcher at the Computational Centre of the USSR Academy of Sciences. Since 1968, he is a the Head of Laboratory and Principal Researcher at the Institute for Problems in Mechanics of the Russian Academy of Sciences. Since 1974, Chernousko is also a Professor of the Moscow Institute of Physics and Technology. F.L.Chernousko has published 14 books and more than 450 scientific papers on mechanics, control theory, applied mathematics, and robotics.

He is a Full Member (Academician) of the Russian Academy of Sciences, Foreign Member of the Serbian Academy of Sciences and Arts, Corr. Member of the International Academy of Astronautics, a member of a number of Russian and international scientific societies and councils, a member of editorial boards of 10 Russian and international scientific journals. F.L.Chernousko was awarded the Leninsky Komsomol Prize for Science (1971), the Medal for Valour in Labour (1971), the USSR State Prize for Science and Technology (1980), the Koerber Prize for European Science (Germany, 1993), A. von Humboldt Award for Science (Germany, 1998), the Russian State Prize for Science and Technology (1998). Academician Felix Chernousko was the Invited lecturer at the XXI Yugoslav Congress of Theoretical and Applied Mechanics organized by the Faculty of Mechanical Engineering, University of Nis at Nis 1995 under the patronage of the Yugoslav Society of Mechanics. His Plenary Lecture was entitled: "Optimal Control of Robotic Systems". Academician Felix Chernousko was the Invited Plenary and Opening Lecturer titled at the Serbian Congress of Mechanics in 2017.

ENOC Budapest 2017 EURODY ROME 2017

Membership

The Member og American Mathematics Society, New York Academy of Sciences, Russian National Committee of Theoretical and Applied Mechanics, Russian Academy of Sciences ; A. von Humboldt award 1998, Chaplygin Gold medal 2005 , International Academy Astronautics, European Academy of Sciences, Serbian Academy of Sciences and Arts, Academy Engineering Sciences Serbia and Montenegro.

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[3] **CELEBRATING JUBILEES: BIRTHDAY CONGRATULATIONS ON THE 80TH BIRTHDAY OF ACADEMICIAN FELIX LEONIDOVICH CHERNOUSKO,** ISSN *1064-2307, Journal of Computer and Systems Sciences International, 2008, Vol. 47, No. 3, pp. 329–331. © Pleiades Publishing, Ltd., 2008. Original Russian Text © The editorial board, 2008, published in Izvestiya Akademii Nauk. Teoriya i Sistemy Upravleniya, 2008, No. 3, pp. 5–7.*

[4] FELIKS LEONIDOVICH CHERNOUSKO (On his 70th birthday), Journal of Applied Mathematics and Mechanics 72 (2008) 103–115.

Composed and Edited by
Katica R. (Stevanović) Hedrih
and
Dmytro Leshchenko

Appendix A. LIST OF THE MAIN SCIENTIFIC PUBLICATIONS OF F.L. CHERNOUSKO

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.
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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 CompMath 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.

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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.
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