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VLADIMIR MEFOD'YEVICH MATROSOV (ON HIS 70TH BIRTHDAY)†

On 8 May 2002, Vladimir Mefod'yevich Matrosov, the great mathematician and mechanician, founder of the Lyapunov vector function method in stability theory, in system dynamics and in control theory, member of the Russian Academy of Sciences, Doctor of Physical and Mathematical Sciences, winner of the USSR State Prize, and Director of the Stability and Non-linear Dynamics Research Centre of the A. A. Blagonravov Mechanical Engineering Research Institute of the Russian Academy of Sciences, celebrated his 70th birthday. The fundamental results that he obtained on the theory of stability of motion, on the development of a comparison method for analysing the various properties of solutions of differential equations and abstract systems, and many others, are of key theoretical and practical importance and are being developed in many countries.

Graduating, with distinction, from the Kazan Aviation Institute in 1956, Matrosov worked there until 1975. On the invitation of the Siberian Division of the USSR Academy of Sciences, in 1975, together with a number of students and colleagues, he moved to Irkutsk, where, thanks to his efforts, in November 1980 the Irkutsk Computer Centre of the Siberian Division of the USSR Academy of Sciences (now the Institute of Dynamics of Systems and Control Theory of the Siberian Division of the Russian Academy of Sciences) was set up. In 1976 he was elected a Corresponding member of the USSR Academy of Sciences, and in 1987 a full member of the Academy. In 1991, Matrosov became the Director of the Moscow Branch of the Institute of Transport Problems of the USSR Academy of Sciences, and since 1996 he has been Director of the Stability and Non-linear Dynamics Research Centre of the A. A. Blagonravov Mechanical Engineering Research Institute of the Russian Academy of Sciences.

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His outstanding results in developing Lyapunov's vector function (LVF) method, which developed the ideas of Chetayev, Bellman and also Chaplygin, brought him worldwide fame. He obtained very general characteristics of the stability of motion, in which each component function satisfies far less strict conditions than in the corresponding theorem with a single Lyapunov scalar function, which facilitates the solution of the central problem of their construction. This fruitful idea was taken up and developed by scientists in the USSR, and also in the United States, Italy, Belgium and Japan. In came into its own in the investigation of various dynamic properties of non-linear systems with applications to complex (large-scale) systems, continuous and discrete, with distributed and lumped parameters. He comprehensively advanced the theory of differential equations in Banach space and, on this basis, formulated the fundamental principle of comparison with LVFs. For a number of non-linear complex systems, including systems with distributed parameters and in the presence of disturbances, with the introduction of LVFs the scope for applying the Lyapunov function method was broadened.

Matrosov and his colleagues developed the main concepts and models of the mathematical theory of systems, covering, from unique aspects, various models of system dynamics and control theory, and they proposed a unified representation of the properties of systems in typical quantifier language and a comparison method as a general method of the mathematical theory of systems. They also developed the concept of a system of processes covering both classical definitions of dynamical systems and their various generalizations, for which many mathematical models, including classical control systems, are interpretations of a continuum model.

Matrosov established, in algorithmic form, the comparison principle to derive theorems on the main dynamic properties of systems of processes, making it possible to obtain formulations and proofs of theorems of comparison with LVFs from definitions of the dynamic properties investigated. The conditions of theorems obtained by means of Matrosov's algorithms depend flexibly on the dynamic property of the system of processes being studied. On this basis, several hundred theorems were obtained on a computer and manually, comparable in content with those obtained in the traditional manner. Matrosov's abstract principle of comparison opened up a new scientific area in the qualitative analysis of the dynamic properties of systems and an original direction in the development of artificial intelligence, termed the algorithmization approach to the logical synthesis of formulations and proofs of theorems of a given class.

Matrosov developed a technique for the mathematical modelling and solution of problems of dynamics and control using software packages. Under his supervision, a unique system of AI software packages, oriented towards methods of non-linear dynamics and control theory, was created.

A finite iteration process of complex system decomposition and aggregation proved to be most effective in applications. Using it, investigations were made of the stability and dynamics of the first Soviet stratospheric observatory, an orbital astronomical observatory with a submillimetre telescope, etc. The results were used to design such systems.

Matrosov created new priority lines of research at the interface between theories of stability, control and differential and functional equations, the mathematical theory of systems, AI research and the theory of large systems, and these had numerous effective outcomes for software and investigations of technical and other systems. The results were developed further in the work by his students and successors, who formed a well-known scientific school in the field of stability and control theory.

Those who know him well are struck by his energy and ability to devote himself completely to his work. As a seminar scientific manager, and Director of the Department of Mathematical Cybernetics of the Moscow Aviation Institute, he makes every effort to train young scientists, inculcating in the young a devotion to sciences, with a success borne of his good will, simple manner, scientific generosity and deep erudition. In every situation he exhibits broad scientific views and outstanding organizational capabilities. Matrosov's team has carried out a large body of research within the framework of the State programme on "Safety of the population and establishments pertaining to the national economy in the light of the risk of natural and man-made catastrophes". This has resulted in the development of the concept of a complex system of mathematical models and of the theory of stable development of the country in the event of disruptions arising from catastrophes. An integrated AI program system has been created for modelling and analysing these problems.

Together with colleagues, Matrosov has obtained important results on the dynamics of mechanical systems with dry friction, developed mathematical models and computer systems for analysing military strategic stability in the world and developed methods for the non-linear analysis of the dynamic properties of complex systems, such as the stability of immunological processes, logical dynamical systems and systems of variable structure. The results of these investigations have been presented in many conference papers, in articles and in five monographs, the most recent of which was published in 2001.

Matrosov was Scientific Manager of the International Project of the Russian Academy of Sciences and UNESCO on "Models, methods and software for analysing global and regional stability of development". He is the author and editor of the encyclopaedic work *A New Paradigm for the Development of Russia in the Twenty-first Century* (Academia, Moscow, 2000). Matrosov and his scientific school have made an enormous contribution to the theory of stable development, and to the development of mathematical models of world dynamics and methods for investigating these models.

March 2002 saw the publication of the Russian State Duma's *Scientific Basis of Strategy for the Stable Development of Russia*, which was written and co-edited by Matrosov. He is Chairman of the Expert Consultative Council at the Commission of the Russian State Duma concerning problems of stable development.

Matrosov is a member of the Russian Ecological Academy, the Academy of Social and Humanitarian Sciences, the International Academy of the Sphere of Practical Human Action, an honorary member of the K. E. Tsiolkovskii Russian Academy of Astronautics and an honorary professor of the Kazan State Technical University. He is the founder and President of the Academy of Non-linear Sciences, which is an interregional public organization bringing together about 200 doctors of sciences embodying a world-leading Russian scientific school in the field of the theory of stability, non-linear dynamic analysis and complex system control theory. The Academy has regional divisions in seven subject areas in Russia, the United States. France, the Ukraine, Yugoslavia and South Africa. Matrosov supervises the organization and holding of international congresses on non-linear analysis and its applications.

His students include a corresponding member of the Russian Academy of Sciences, seven doctors of science, and 12 masters of science.

V. M. Matrosov has reached his 70th birthday at the height of his creativity and brimming with energy and new plans. The editorial board of Applied Mathematics and Mechanics send their warm congratulations on his birthday and wish him good health and further success in his many activities.

Translated by P.S.C.