ON THE 110TH ANNIVERSARY OF ACADEMICIAN BORIS N. PETROV'S BIRTH

March 11, 2023, marked the 110th anniversary of Academician Boris Nikolaevich Petrov's birth. He was an outstanding scientist and scientific organizer in the field of automatic control. B.N. Petrov's R&D activities were closely connected with Trapeznikov Institute of Control Sciences (the USSR, then Russian, Academy of Sciences; before 1969, the Institute of Automation and Remote Control, the USSR Academy of Sciences), where he rose from the engineer to the world-renowned scientist. From 1947 to 1951, he was Director of the Institute.

Boris Nikolaevich was remarkable for his encyclopedic knowledge and wide range of research interests. Actively working in the general theory of automatic control, he always selected the most relevant problems.

He developed the structural transformation method for the block diagrams (schemes) of automatic systems and a corresponding mathematical apparatus, the algebra of structural transformations. B.N. Petrov is a founder of the theory of invariant control systems. His multifaceted investigations on invariance theory resulted in new principles and structures for various types of combined systems.

In 1957, Boris Nikolaevich led the research in the theory, design, and development of searchless self-adaptive systems (adaptive systems with a model). Under his guidance and participation, adaptive control systems for several classes of rockets by Chief Designer I.S. Seleznev were designed and developed, for the first time in the USSR.

B.N. Petrov's studies of nonstationary (time-varying) and multivariate systems, as well as his contributions to sensitivity theory and control algorithm design as an inverse dynamics problem, are widely known.

Boris Nikolayevich was a talented teacher. He began tutoring at Ordzhonikidze Moscow Aviation Institute in 1944 by creating a new course of lectures on the automation of motors and propellers. The significance of that course went beyond the technical narrative: in his lectures, B.N. Petrov delivered to the students the most important and recent results in the theory of automatic control of those years.

In 1954, the Institute was entrusted by a government decree to lead R&D works on a propulsion control system for the intercontinental ballistic missile developed by S.P. Korolev. Boris Nikolaevich took responsibility for the ideology of a fundamentally new class of systems—terminal fuel control systems for liquid-propellant engines—that significantly increased the rocket's power output by sharply reducing the guaranteed fuel reserves.

The development of thrust control systems for liquid-propellant engines and the synchronization of tank emptying for complex-architecture rockets were acute problems. They were accompanied by many challenges on the pathway of creating fundamentally new systems that started from scratch, without any background history, prototype systems, and literature sources.

The results of R&D works by B.N. Petrov and the Institute's employees during collaboration with academician S.P. Korolev, OKB-1 Chief Designer, and other outstanding Soviet scientists and engineers in the field of space rocket technology contributed significantly to developing onboard control systems of

launch vehicles, particularly the launch of the first artificial Earth satellite and Yu.A. Gagarin's pioneering space flight.

The results obtained by Boris Nikolayevich and his team were of a fundamental character. The control systems on their basis became an integral part of all large liquid-propellant rockets developed by chief designers S.P. Korolev, M.K. Yangel, V.N. Chelomey, and V.F. Utkin.

B.N. Petrov's ideas were further refined and applied in modern R&D works of the Institute in the field of rocket and space technology. They were embodied in terminal control systems for a new generation of launch vehicles and upper stages for space and defense applications (modernized Soyuz-2, the Angara family, Sarmat, Soyuz-5, Amur, and oxygen-hydrogen heavy-class upper stages (KVTK)).

Since 1956, an important area of B.N. Petrov's work was the theory and control systems for artificial Earth satellites. Boris Nikolayevich participated in the following activities: creating pre-damping systems for gravitationally stabilized Earth satellites, control systems for communication satellites and direct TV broadcasting satellites in the geostationary orbit, and several multi-seat manned orbital aircraft; developing automatic stations; injecting the world's first artificial moon satellite into a near-moon orbit.

In the last years of his life, B.N. Petrov headed the Intercosmos Council of the USSR Academy of Sciences. He was in charge of the successful development and implementation of major international space programs. Among them, note the Soyuz-Apollo project involving researchers, engineers, and designers from the USSR and the USA. Petrov personally contributed to solving numerous organizational, scientific, and technical problems of the project.

Under Boris Nikolaevich's guidance, large professional teams grew up. His scientific school successfully develops topical problems of modern control theory.

B.N. Petrov wrote about 200 journalistic and popular science articles on major scientific problems in automation, computer engineering, experiment automation, and program management of space research. He supported everything new and promising in science and repeatedly emphasized the importance of developing a mathematical or abstract systems theory. As he said, this theory extends the horizons of control science.

Boris Nikolaevich was not only a great researcher but also an outstanding scientific organizer. In 1953, he was elected Corresponding Member of the USSR Academy of Sciences; in 1960, Academician of the Academy. Since 1963, B.N. Petrov was the Academician-Secretary of the Department of Mechanical Engineering and Control Processes (the USSR Academy of Sciences); in 1979, he was elected Vice-President of the USSR Academy of Sciences.

B.N. Petrov was entitled the Hero of Socialist Labor. He was awarded the Order of Lenin (5 times), the Order of the October Revolution, the Labor Red Banner Order, the Red Star Order, as well as the USSR Lenin and State Prizes.

Boris Nikolaevich's activities were widely recognized in other countries. He was Full Member of the International Academy of Astronautics and Foreign Member of the Czechoslovak, Hungarian, Bulgarian, and Polish Academies of Sciences. Moreover, he was awarded several foreign orders and the Gold Medal of the French National Center for Space Research.

In August 1980, an untimely death took B.N. Petrov away, full of creative energy. In November 1980, the Government issued a decree on perpetuating his memory. The Presidium of the USSR Academy of Sciences established the Petrov Gold Medal (since 1993, the Petrov Prize), awarded for outstanding research in the theory and systems of automatic control and experimental research in space exploration.

The name of Boris Nikolaevich Petrov will forever remain in the annals of the national science of control and astronautics.

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