

**IVAN GAVRILYUK – 70**



Our friend of long standing, colleague, and collaborator, Professor Ivan Gavrilyuk (german Gawriljuk), has turned 70.

He was born and grew in the village Majdan Stasiv (currently Goncharivka) of Lityns'kyj district of Vinnitsa region, Ukraine. School he graduated in the village Klembivka of Jampil' district of the same region. His professional activity of almost four decades in two countries, Ukraine and Germany, is a splendid example of ceaseless service to the mathematical community and is noted for remarkable scientific achievements in a wide range of topics in the area of theoretical numerical analysis, mathematical modelling, and scientific computing.

I.P. Gavrilyuk studied mechanics and mathematics at the Faculties of Mechanics and Mathematics and then at the Faculty of Cybernetics of the Taras Shevchenko Kiev State University. He graduated in 1971 from the department of Cybernetics and, as a talented young mathematician, was appointed as assistant professor at the department. His mentors, collaborators, and colleagues at that time were G.N. Polozhij, V.M. Glushkov, V.L. Makarov and other well-known mathematicians from the Kiev school. In 1975 he defended his thesis for the degree of Candidate of Sciences in physics and mathematics at the Taras Shevchenko Kiev State University. In 1979 he was promoted to the post of associate professor of applied statistics and soon to associate professor of computational methods in mathematical physics.

In the period from 1981 to 1989 Makarov and Gavrilyuk were, respectively, chair and vice-chair of the Department of numerical methods of mathematical physics at the Kiev National University of Ukraine. Under their leadership the department became a leading organization in Ukraine in the area of numerical and applied mathematics. Makarov and Gavrilyuk were largely responsible for the grown prestige of the department and for the raised quality of research. Dr. Gavrilyuk was part of a team of young scientists with a vigorous research program and close scientific collaboration with the world-renowned mathematical schools.

In 1989 Dr. Gavrilyuk made a crucial decision to move to Germany with his wife Ingrid and their children Alexander and Kristina. That year was a turning point in the European history, when young professionals were looking for new opportunities in the new world that was about to be created after the fall of the Berlin wall. In 1989–1999 Dr. Gavrilyuk was a Lecturer, Privatdozent at the Institute of Mathematics, Faculty of Mathematics and Informatics, University of Leipzig and in 1995 he defended his Dr. rer. nat. habilitation at this university. His close collaborators and mentors in Leipzig were the well-known mathematicians Eberhard Zeidler, Damir Arov and Wolfgang Hackbush.

In 1999 Dr. Gavrilyuk was appointed Professor and Chairman of the department of Information and Communication Technologies at the newly founded University of Cooperative Education, Berufsakademie Eisenach, Staatliche Studienakademie Thueringen, later transformed into dual University Gera-Eisenach. These universities represent a new internationally recognized education form, so to say the german "know-how" in the field of closed to practice education. Professor Gavriljuk made a significant contribution to the development of this form of education.

In the earlier period of his professional career as scientist, namely 1971–1975, Dr. Gavrilyuk's research was focused on the theory of finite difference schemes. In this period he initiated a study of a new class of finite difference schemes, namely schemes with exact and explicit spectra. He also introduced the concept of the best scheme with exact spectrum, which was the forerunner of the modern spectral and pseudospectral methods. Dr. Gavrilyuk made important contributions to the development of the theory of exact and truncated difference schemes for variational inequalities and for degenerate ODE's, the direction initiated and developed into a powerful numerical tool in the early 1960s by A.N. Tikhonov and A.A. Samarskii and later in the 1970s by V.L. Makarov. Among the most spectacular achievements of Dr. Gavrilyuk in this area are his results on the existence and uniqueness of exact difference schemes for the weak solutions. They have been used further as the basis for the construction of truncated difference schemes of arbitrary given degree of accuracy as well as of difference schemes on a finite grid for ordinary and partial differential equations in unbounded domains. In the period from 1975 to 1989 Dr. Gavrilyuk participated also in a number of theoretical and applied projects related to mathematical modelling and computer-aided design of complex radio-engineering systems. He headed a team for developing a mathematical model of photon recycling diode and used it for computer simulation of photon recycling. It was probably the first mathematical model which could completely describe all complex processes in this electronic device. Due to the strong nonlinearity and nonlocal terms the investigation of this model and its discretization was a challenging mathematical problem. Further, Dr. Gavrilyuk and his team proposed a new model (a system of nonlinear partial differential equations) of internal-diffusion kinetics of adsorption, derived an appropriate discretization, and developed efficient algorithms and computer programs for its numerical solution. This was a team-work of applied mathematicians and engineers that led

to a number of unique results in terms of mathematical modelling, development of numerical algorithms and software for computer simulation.

In 1989 Dr. Gavriilyuk, while working at the University of Leipzig, began a new line of research. He studied differential equations with operator coefficients and other operator equations in Hilbert and Banach spaces, which can be considered as meta-models for partial differential equations. Using the Cayley transform and special functions he obtained the solution operators and closed form solutions of these meta-models containing, e.g., all the three important classes of partial differential equations (parabolic, hyperbolic and elliptic), operator equations (including Lyapunov, Silvester, and other important equations). On the basis of these explicit solutions he was able to construct and justify numerical schemes without accuracy saturation and with exponential accuracy.

Further Dr. Gavriilyuk applied the improper Dunford-Cauchy integral to represent the solution operators and to discretize them using Sinc-quadratures. These algorithms have three important properties: a) they converge exponentially, b) they can be parallelized, and c) in the case of multidimensional problems they allow a tensor-product representation. These important properties yield efficient numerical algorithms of optimal or low complexity, which in the case of multidimensional problems solve the famous "curse of dimensionality" problem. The tensor-product representations of the solution operators has become a crucial tool (very often the only working tool) for many multidimensional problems and is intensively developing at various scientific institutions. Dr. Gavriilyuk's colleague, friend and collaborator in this important field from Leipzig school is Boris Khoromskij.

An important field of Dr. Gavriilyuk's scientific activities in University of Leipzig was mathematical modelling of the sloshing of liquids in moving containers in various marine applications. These phenomena are described by a complex system of nonlinear partial differential equations in domains with moving boundaries. The main idea of the approach used by Dr. Gavriilyuk in a team with I. Lukovskij, V. Makarov, A. Timokha, M. Hermann and others is to derive simpler mathematical models (so-called modal models) in the form of a system of ODEs. Then he proposed efficient numerical algorithms that for various applications lead to boundary-value, initial-value, or eigenvalue problems for the modal models.

Dr. Gavriilyuk has shown how the seemingly "abstract" mathematical results in terms of numerical functional analysis in Hilbert and Banach spaces could be converted into practical algorithms for solving particular applied problems connected with the sloshing of liquids. In fact, using the full arsenal of theoretical mathematical tools for the computational practice is very typical for the research of Dr. Gavriilyuk.

Professor I.P. Gavriilyuk lectured for 18 years at the Kiev University, then for 10 years at the University of Leipzig and afterwards till now at the dual Gera-Eisenach-university. He has given a whole spectrum of undergraduate, graduate, and special topics courses in numerical methods, computer science, and mathematical modelling and has supervised a large number of diplomas and Ph.D. theses.

Results published by Prof. Gavrilyuk are widely known in the scientific world and make an important contribution to mathematics. Scientific achievements of Professor Gavrilyuk were awarded the State Prize of Ukraine in the field of science and technology.

As editor Prof. Gavrilyuk left his mark in a number of mathematical journals, e.g., *Mathematics of Computation*, *Computational Methods in Applied Mathematics*, *Journal of Numerical and Applied Mathematics*. He has been invited speaker at a number of International conferences, symposia, and workshops. Prof. Gavrilyuk is the author or co-author of 9 monographs, a number of university textbooks, and more than 150 research papers.

He is full of energy, new scientific ideas, and research endeavours. We warmly congratulate the jubilee and wish him good health, fulfilment of his plans, and Many Happy Returns of The Day!

R. Chapko, V. Khlobystov, M. Kutniv, I. Lukovskyj, V. Makarov,  
H. Shynkarenko, A. Timokha, V. Trotsenko, V. Vasylyk.