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Ivan Gavrilyuk — 60

Professor Ivan Petrovich Gavrilyuk, our friend of long standing, colleague, and collaborator, has turned 60. 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 graduated in 1971 from the Department of Cybernetics of the Taras Shevchenko Kiev State University and, as a talented young mathematician, he 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 Russian Academy of Sciences, in particular, with the world-renowed mathematical schools of academicians A. N. Tikhonov and A. A. Samarskii.

In 1989 Dr. Gavrilyuk made a cruicial decision to move to Germany. 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. His close collaborators and mentors in Leipzig were the well-known mathematicians E. Zeidler and W. Hackbush. In 1999 Dr. Gavrilyuk was appointed Professor and Chairman of the department of Information and Communication Technologies at the University of Cooperative Education, Berufsakademie Eisenach, Staatliche Studienakademie Thueringen, where he works currently.

In the earlier period of his professional career, 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 is 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. 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 discreztization 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. Gavrilyuk, 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 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.

In the last decade Dr. Gavrilyuk together with V. Makarov 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. An important field of Dr. Gavrilyuk's scientific activities in Germany is 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. Gavrilyuk in a team with I. Lukovskyj, 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. Gavrilyuk 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. Gavrilyuk.

Professor I. P. Gavrilyuk lectured for 18 years at the Kiev University and then for 10 years at the University of Leipzig. 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. Professor Gavrilyuk is an active participant and organiser of new education forms at the University of Cooperative Education (Berufsakademie Eisenach, Germany) which combines theoretical study with a practical training in the field of Information and Communication Technologies.

Results published by Dr. Gavrilyuk are widely known in the scientific world and make an important contribution to mathematics. Dr. Gavrilyuk is a member of the editorial boards of 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. Dr. Gavrilyuk is the author or co-author of 9 monographs, a number of university textbooks, and more than 150 research papers. The full list of his publications is available from http://www.ba-eisenach.de/ipg-pub.0.html.

I. P. Gavrilyuk 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, M. Hermann, B. Jovanovich, V. Khlobystov, M. Kutniv, R. Lazarov, I. Lukovskyj, V. Makarov, P. Matus, A. Timokha, V. Trotsenko, and V. Vasylyk

Selected Publications

Books:

1. I. P. Gavrilyuk, I. A. Lukovsky, V. L. Makarov, A. N. Timokha, *Evolutional problems of the contained fluid*. Kiev: Publishing House of the Institute of Mathematics of NASU, 2006. 233 pp. ISBN 966-02-3949-1.

2. I. P. Gavrilyuk, V. L Makarov, *Strongly positive operators and numerical algorithms without accuracy saturation*. Kiev, Publishing House of the Institute of Mathematics of the Academie of Sciences of Ukraine, 2004. 499 pp. (in Russian). ISBN 966-02-2571-7.

Research papers:

1. I. P. Gavrilyuk, *Approximation of the operator exponential and applications*, CMAM **7** (2007), no. 4. pp. 294–320.

2. T. Yu. Bohonova, I. P. Gavrilyuk, V. L. Makarov, and V. Vasylyk, *Exponentially Convergent Duhamel-Like Algorithms for Differential Equations with an Operator Coefficient Possessing a Variable Domain in a Banach Space*, SINUM, **46** (2000), Iss. 1, pp. 365–396

3. I. P. Gavrilyuk, I. A. Lukovsky, I. Yu. Trotsenko, and O. Timokha, *Sloshing in a vertical circular cylindrical tank with an annular baffle. Part 1. Linear fundamental solutions*, Journal of Engineering Mathematics, **54** (2006), pp. 71–88.

4. I. Gavrilyuk and V. Makarov, *Algorithms without accuracy saturation for evolution equations in Hilbert and Banach spaces*, Math. Comp. **74** (2005), pp. 555–583.

5. I. P. Gavrilyuk, W. Hackbusch, and B. N. Khoromskij, *Data-sparse approximation of a class of operator-valued functions*, Math. Comp. **74** (2005), pp. 681–708.

6. I. P. Gavrilyuk, W. Hackbusch, and B. N. Khoromskij, *Tensor-Product Approximation to Elliptic and Parabolic Solution Operators in Higher Dimensions*, Computing, **74** (2005), pp. 131–157.

7. I. Gavrilyuk, I. Lukovsky, and O. Timokha, *Linear and nonlinear sloshing in a circular conical tank*, Fluid Dynamics Research, **37** (2005), pp. 399–429.

8. I. P. Gavrilyuk and V. L. Makarov, *Exponentially convergent algorithms for the operator exponential with applications to inhomogeneous problems in Banach spaces*, SIAM Journal on Num. Anal., **43** (2005), No. 5, pp. 2144–2171.

9. I. Gavrilyuk, I. Lukovsky, and O. Timokha, *Two-dimensional Vibroequilibria and Faraday's drops*, Z. Angew. Math. Phys. (ZAMP), **55** (2004), pp. 1015–1033.