COMPUTATIONAL METHODS FOR BOUNDARY AND INTERIOR LAYERS

Dedicated to G. I. Shishkin on the occasion of his 70th birthday

This special issue is dedicated to G. I. Shishkin to mark the occasion of his 70th birthday. This issue contains invited research articles on all aspects of computational methods for boundary and interior layers.

Grigorii Ivanovich Shishkin was born in Petrodvoretz, a municipal town near Saint Petersburg, on 28 January 1939. In 1961 he graduated from the Leningrad Technological Institute as an inorganic chemist, and then from 1961 to 1966, he was the leader of a research group in the Ural Scientific Research Institute of Chemistry in Ekaterinburg (Sverdlovsk at that time). During this period as a research chemist, Shishkin experienced the time lag between a new idea and the arrival of suitable experimental equipment, which led him to a stronger interest in mathematics. Consequently, in 1966, he changed positions to become an Engineer at the Institute of Mathematics and Mechanics (IMM) in Ekaterinburg. In 1967 he graduated from the Ural State University in Ekaterinburg as a mathematician, and in 1971 he was promoted to the position of scientific researcher in the IMM.

Shishkin obtained his first doctoral thesis entitled *"On a certain problem with a free boundary for a system of parabolic equations"* from the Ural State University in 1974. From 1973 until 1986, he was the head of a research laboratory in IMM working on five broad research themes involving mathematical modelling of problems arising in physics, chemistry and metallurgy. These practical problems involved mathematical modelling of welding and surfacing processes, heat and mass transfer for crystal growth, a fluidized-bed apparatus, tube-dryers used in the chemical industry, heat regimes in electronic equipment, metal inversion voltammetry and electro-chemical analysis. Two patents, entitled "Method of Electroslag Welding"

and "Hardsurfacing Device", emanated from this work.

In 1991 he was awarded his second doctoral thesis in Computational Mathematics from the Keldysh Institute of Applied Mathematics, Moscow. The contents of this thesis subsequently appeared as the monograph *"Discrete Approximation of Singularly Perturbed Elliptic and Parabolic Equations"*, which was published by the Ural Section of the Russian Academy of Sciences in 1992. Currently, Shishkin is a Leading Research Scientist in the Institute of Mathematics and Mechanics in Ekaterinburg, Russia.

Over the years, Shishkin has collaborated with research teams in Russia and abroad, in Bulgaria, Ireland, the Netherlands, Singapore, Spain and the United States. In particular, he developed strong enduring research links with a group of Irish numerical analysts, and with Pieter Hemker in Amsterdam, the Netherlands. These links were initiated at a BAIL conference in Novosibirsk, USSR in 1986. Consequently, from 1990 onwards, Shishkin has regularly visited Ireland and the Netherlands and participated in various collaborative projects. Two monographs and numerous journal publications emanated directly from these collaborations.

Shishkin's main research interests lie in the area of numerical methods for computationally challenging singularly perturbed problems that arise in all branches of science and engineering. Classical numerical methods are inadequate for such problems due to the presence of boundary or interior layers. In particular, he is interested in numerical methods that converge uniformly in the singular perturbation parameter(s) (so-called parameter-uniform methods). One significant result by Shishkin was about the non-existence of a parameter-uniform finite difference method on a uniform mesh (such methods are called exponentially-fitted methods) for problems whose solutions contain parabolic or characteristic boundary layers. This result eventually stimulated a new interest in layer-adapted meshes as an alternative to exponentially-fitted methods. Furthermore, Shishkin created a new layer-adapted mesh, for which he is probably best known, to deal with these parabolic layers and other classes of singularly perturbed problems. This easy-to-use computational tool is now well-known in the literature as the **Shishkin mesh**. A Google search for *Shishkin mesh* yields over 10,000 hits. He has also made important advances in the design and analysis of new numerical methods for several different classes of singularly perturbed problems.

Shishkin's published results appear in five books and over 300 research papers in many international journals. He continues to be involved in various research projects and produce several papers every year. In 2008, he (jointly with his wife and research colleague L. P. Shishkina) published a monograph entitled *"Discrete Approximation of Singular Perturbation Problems"*, which highlights some of his central results from his numerous publications over the years. We wish him continued success in his search for further deep scientific results.

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