

## EDITORIAL

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This issue of Applications of Mathematics contains several contributions presented at the International Conference Applications of Mathematics 2018, August 22 to 25. This conference is the fourth in the series of Application of Mathematics conferences organized by the Institute of Mathematics of the Czech Academy of Sciences in Prague. It continues the tradition of meetings focused on a wide variety of applications of mathematics, including computational mathematics and mechanics, numerical analysis, and mathematical physics. On top of these traditional topics, there was a special session devoted to eigenvalue problems, their efficient and reliable numerical solution, and guaranteed bounds on eigenvalues.

The first paper by J.-P. Lessard focuses on a new method of computing discrete convolutions with verified accuracy using the fast Fourier transform, the properties of Banach algebras of bi-infinite complex valued sequences and interval arithmetic. The purpose of this approach is to improve the implementation and the applicability of computer-assisted proofs performed in weighed  $l^1$  Banach algebras of Fourier/Chebyshev sequences, whose norms are known to be numerically unstable.

A. Khademi, S. Korotov, and J. E. Vatne propose a special maximum angle condition for the case of pentahedral prismatic elements with six degrees of freedom. Under this condition, prisms in finite element meshes may degenerate in certain ways, violating the standard inscribed ball condition, but the interpolation error remains of the order  $O(h)$  in the  $H^1$ -norm for sufficiently smooth functions.

I. Faragó, M. E. Mincsovcics, and R. Mosleh investigate Ross and delayed Ross-Macdonald models for propagation of malaria. For both models they derive sufficient conditions for the time-discretization step-size parameter that guarantees density preservation property for the explicit Euler method. On top of that they prove this property for both models unconditionally in the case of the implicit Euler method.

H.-G. Roos discusses difficulties appearing in numerical solutions of systems of reaction-diffusion problems. A priori error estimates of finite element methods for these problems are often proved in the related energy norm. However, in the

singularly perturbed case this norm is not adequate. A different scaling of the  $H^1$ -seminorm leads to a balanced norm which reflects the layer behavior correctly.

Y. He, Y. Li, H. Xie, C. You, and N. Zhang study a new type of multilevel method for solving eigenvalue problems. The problem on the finest finite element space is replaced by solving a small scale eigenvalue problem in a coarse space and solving a sequence of augmented linear problems, derived by Newton's method in the corresponding sequence of finite element spaces.

J. Vala and P. Jarošová show a rather new interdisciplinary research branch, combining knowledge from physics, engineering, art, and social science for advanced design of buildings. They optimize several parameters in the classical initial-boundary heat conduction problem in non-homogeneous and anisotropic media. This approach with a nonlinear thermal radiation is then applied to design a low-energy house in Ostrov u Macochy.

The paper by O. Čertík, F. Gardini, G. Manzini, and G. Vacca considers the Laplace eigenvalue problem with a potential term and describes its discretization by the virtual element method. This method allows quite general polytopic meshes and the authors provide its convergence analysis and error estimates.

The last paper authored by Q. Li and X. Liu derives an explicit a priori error estimate for finite element solution of nonhomogeneous Neumann problems. Interestingly, the constant appearing in this estimate can be computed by the method of hypercircle.

The Scientific Committee of the Conference Applications of Mathematics 2018 consisted of Mark Ainsworth (Brown University), Gabriel Barrenechea (University of Strathclyde), István Faragó (Eötvös Loránd University), Miloslav Feistauer (Charles University), Antti Hannukainen (Aalto University), Qun Lin (Academia Sinica), Hans-Goerg Roos (Technical University Dresden), Karel Segeth (Czech Academy of Sciences), Martin Stynes (Beijing Computational Science Research Center), Takuya Tsuchiya (Ehime University), Hehu Xie (Academia Sinica), Shuhua Zhang (Tianjin University of Finance and Economics), and Zhimin Zhang (Wayne State University). During the Conference we organized a dinner to celebrate the 50th birthdays of Jan Brandts and Sergey Korotov. We also had a guided walk through mathematical, physical, and astronomical sightseeing of Prague.

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