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Editorial

Feature Paper Collection of *Mathematical and Computational Applications*—2022

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This Special Issue comprises the first collection of papers submitted by the Editorial Board Members (EBMs) of the journal *Mathematical and Computational Applications* (MCA), as well as outstanding scholars working in the core research fields of MCA. Therefore, this collection typifies the most insightful and influential original articles that discuss key topics in these fields. More precisely, this book contains 11 chapters from 11 research articles published in MCA between January and November 2022. The papers are in the following shortly presented, organized chronologically by their publication times.

In [1], Monika Stipsitz and Hélios Sanchis-Alepuz present a proof-of-concept study of the application of convolutional neural networks to accelerate thermal simulations. Hereby, the focus is on the thermal aspect of electronic systems to provide accurate approximations of full solutions to quickly select promising designs. To this end, a custom network architecture that captures the long-range correlations present in heat conduction problems is proposed and tested.

In [2], Roy M. Howard utilizes a spline-based integral approximation to define a sequence of approximations to the error function that converge at a significantly faster manner than the default Taylor series. Specifically, two generalizations are investigated, both leading to significantly improved accuracy.

In [3], Sorena Sarmadi et al. perform automated analysis to quantify the growth dynamics of a population of bacilliform bacteria. To this end, they propose an innovative approach to the frame-sequence tracking of deformable-cell motion by the automated minimization of a new specific cost function. Initial tests using experimental image sequences of E. coli colonies yield convincing results, with a registration accuracy ranging from 90% to 100%.

In [4], Guzel Khayretdinova et al. propose a method for semi-supervised image segmentation based on geometric active contours. The main novelty of the proposed method is the initialization of the segmentation process, which is performed with a polynomial approximation of a user-defined initialization. The method is compared with other segmentation algorithms, and experimental results are given related to several medical and geophysical applications.

In [5], Moriz A. Habigt et al. conduct a porcine animal model to parameterize and evaluate a computer simulation model. The results of an animal model on thirteen healthy pigs were used to generate consistent parameterization data for the full heart computer simulation model. Numerical results show that the simulation model used in this study was able to adapt to the high physiological variability in the animal model.

In [6], Harri Hakula deals with harmonic extension finite elements for the numerical solution of partial differential equations defined on complicated domains. It is shown that, in combination with simple replacement rule-based mesh generation, the performance of the method is equivalent to that of the standard p-version in problems where the boundary

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layers dominate the solution. The performance over a parameter range is demonstrated in an application of computational asymptotic analysis, where known estimates are recovered via computational means only.

In [7], Daniele Mortari proposes a least-squares-based numerical approach to estimate the boundary value geodesic trajectory and associated parametric velocity on curved surfaces. Numerical examples are provided for several two-dimensional quadrics for which the estimated geodesic solutions yield residuals at the machine-error level.

In [8], Lindomar Soares Dos Santos et al. derive analytical solutions of microplastic particles dispersion using a Lotka–Volterra predator–prey model with time-varying intraspecies coefficients. Based on this, they solve analytically particular situations of ecological interest, which are characterized by extreme effects on predatory performance, and propose a second-order differential equation as a possible next step to address this model.

In [9], Quoc Khanh Nguyen et al. present a spectral analysis of the coefficient matrices associated with the linear systems stemming from the finite-element discretization of a linearly elastic problem for an arbitrary coefficient field in three spatial dimensions. Their analysis is then used to design and study an optimal multigrid method in the sense that the (arithmetic) cost for solving the problem up to a fixed desired accuracy is linear in the corresponding matrix size.

In [10], Sohail A. Khan and Tasawar Hayat examine the impacts of Dufour and Soret in a radiative Darcy–Forchheimer flow. They investigate physical interpretations of the concentration, entropy rate, velocity, and temperature parameters, and compare their observations with previously published results, leading to an excellent agreement.

Finally, in [11], Gabriel Thomaz de Aquino Pereira et al. present a new material model for an agglomerated cork based solely on well-known hypotheses of continuum mechanics using fewer parameters than the classical model. Furthermore, a finite-element framework is used to validate the new model against experimental data. This work represents an important step toward the production of materials that are less polluting and harmful to the environment following the UN 2030 agenda for sustainable development.

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