Preface on the special issue: “PDE: models, optimization and numerics”

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Data-driven PDE-based mathematical models, appropriate and accurate numerical methods and the PDE optimization are of importance and much needed today in various direct real-world and industrial problems in order to understand and automatize the intricacies of the actual problem. This in turn opens up a lot of challenges in developing new PDE theories, numerical methods and PDE-based optimization tools. This special issue brings out five original contributions, keeping in align with the theme, from the invited researchers who have wide experience in their respective areas of research.

Prof. Martin Frank of Karlsruhe Institute of Technology, Germany, and the co-author derive an intrusive method, which adaptively switches between Stochastic Collocation and Intrusive Polynomial Moment updates by locally refining the quadrature set on which the solution is calculated in turn reduces numerical costs and allows non-oscillatory reconstructions, and successfully tested on Burger’s equation, where the non-oscillating solution approximations fulfilling the maximum principle.

Prof. Axel Klar of TU Kaiserslautern, Germany, and his collaborators have applied a Semi-Lagrangian schemes with meshfree interpolation, based on a Moving Least Squares (MLS) method, to solve the BGK model for rarefied gas dynamics. Subsequently, Sod’s shock tube

problems are analyzed for a large range of mean-free paths in one-dimensional physical space and three-dimensional velocity space.

Prof. Rathish Kumar of IIT Kanpur, India, and his co-worker prove the existence and uniqueness of the Bido-main model with the Morris and Lecar ionic model. The global existence of solution is established based on regularization argument using Fedo–Galerkin/Compactness approach. The uniqueness of the solution is shown based on Gronwall’s Lemma upon some special treatment of nonlinear terms. The computational realization of the Monodomain model with different reduced ionic test models is demonstrated.

Prof. Agnieszka Wylomanska of Wrocklaw Institute of Science and Technology, Poland, and her collaborators propose a new estimation method for the parameters of the bidimensional autoregressive model of order 1. The procedure is based on fractional lower-order covariance. The use of this method is reasonable from the theoretical point of view. The practical aspect of the method is justified by showing the efficiency of the procedure on the simulated data.

Prof. Vasudevamurthy of TIFR CAM, India, and his team propose a machine learning technique for time series data which combines statistical features and neural networks. The proposed algorithm is tested on various time series like stock prices, astronomical light curve and currency exchange rates.

These mathematical treatment and the rigor will further lead to new challenges and interesting research, for sure.

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