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EDITORIAL

Advanced computational engineering

It is with pleasure that we offer the readers of the *International Journal of Computer Mathematics* this special issue consisting of some of the most significant contributions to computational and mathematical methods with advanced applications in engineering presented at the International Conference on Mathematical Modelling in Engineering & Human Behaviour 2012, held at the Instituto Universitario de Matemática, Multidisciplinar, Polytechnic City of Innovation in Valencia, Spain, September 4–7, 2012, cf. http://jornadas.imm.upv.es/2012/

Since its founding, the International Conference on Mathematical Modelling in Engineering & Human Behaviour has been a truly multi-disciplinary conference, covering all aspects of applied mathematics in a very broad field of areas of science and engineering with its increasing level of complexity. The aim of this conference series is to encourage cross-fertilization between different disciplines and to gain new insights into the emerging research trends in mathematical modelling and engineering methods.

The first paper of this special issue, Zhyrova and Štys [15], analyses the self-organizing Belousov–Zhabotinsky reaction system reporting both experimental and theoretical results. The authors provide results using point information gain entropy and multivariate analysis.

The article, *Evaluation of combustion models based on FPI and presumed pdf approach for Diesel spray simulation*, by García-Oliver *et al.* [5], considers two combustion models, based on the flame prolongation of ILDM method, that were implemented in the CFD platform `OpenFOAM`. These models were evaluated by means of a parametric study of a single Diesel spray demonstrating the importance of the subgrid turbulence–chemistry interaction on the accuracy of the auto-ignition process and the Diesel flame structure.

The third article, *Study of the influence of the needle eccentricity on the internal flow in diesel injector nozzles by CFD calculations*, [12], performs computational tests to study at typical operating conditions of a diesel engine the effects of the needle eccentricity in a real multihole microsac nozzle. Hereby, the internal flow is solved by a multiphase ow solver and the turbulence effects are treated by RANS methods with a RNG k–ε model. The numerical results demonstrate the huge influence of the needle position on the flow characteristics.

The research by Aznar *et al.* [1] deals with the problem of resource location in unknown environments for robotic systems, which are composed of multiple simple robots (swarm) rather than one highly capable robot. To do so, a micro/macroscopic mathematical model is designed to efficiently study a swarm robotic system and to predict their long-term behaviour.

In their work, *Preconditioning the solution of the time dependent neutron diffusion equation by recycling Krylov subspaces*, González-Pintor *et al.* [7] study two preconditioning strategies for Krylov subspace methods in order to improve the convergence rate and solve a set of linear systems associated with the numerical integration of the transient neutron diffusion equation.

In *Difference schemes for time-dependent heat conduction models with delay* [3], the authors develop an explicit finite-difference scheme for a model with time-dependent coefficients and study their convergence and stability properties.

The work *Wall-adapting subgrid-scale models to apply to large eddy simulation of internal combustion engines* [10] considers the application of localized subgridscale models to large eddy simulation of internal combustion engines, especially the dynamic Smagorinsky and the WALE model. The models are implemented in `OpenFOAM` and validations with experimental data exhibit a good accuracy with respect to bulk flow statistics.

Serrano *et al.* [14] apply gas dynamic tools to analyse the air management in internal combustion engines. Here, the authors use an adaptation of the two-step Lax&Wendroff method and the CE–SE method to solve numerically a shock-tube test and compare it with experimental results.

In the article *Mixed intelligent-multivariate missing imputation*, Gibert [6] considers the multivariate missing data imputation method (mixed intelligent-multivariate missing imputation) based on clustering and applies it to World Health Organization data.

Computing matrix exponentials accurately and efficiently is a very important task, e.g. to compute the propagator of a differential equation. *Accurate and efficient matrix exponential computation* [13] proposes a new algorithm that presents similar cost or lower than the state-of-the-art Padé algorithms with mostly higher accuracy results and avoiding Padé's denominator condition problems.

In *Methodology to resolve the transport equation with the discrete ordinates code TORT into IPEN/MB-01 reactor*, by Bernal *et al.* [2], the authors present a discrete ordinates code for solving steady-state neutron transport equation in a nuclear pool reactor.

Application of the level set method for the visual representation of continuous cellular automata oriented to anisotropic wet etching [9] shows how continuous cellular automata can simulate accurately the process of chemical etching used in micro-electro-mechanical-systems (MEMS) micromachining. In this paper, a minimum energy model implemented with the level set method for improving the visual representation of simulated MEMS is presented.

Ramos-Martínez *et al.* [11] analyse the potential influences that drinking water distribution systems have in biofilm development and apply various machine learning algorithms based on naïve Bayesian networks.

In their article *Modelling driving behaviour and its impact on the energy management problem in hybrid electric vehicles*, Guardiola *et al.* [8] discuss the problem of optimally splitting the power demands among the different energy sources (batteries and fuel) in a hybrid electric vehicle. The paper proposes different methods to model driving patterns with a stochastic approach to obtain more accurate predictions of future driving conditions that are needed to optimise the energy management in the vehicle.

The research underlying the article by Cornolti *et al.* [4] considers a Lagrangian model to predict the first stages of the combustion process in SI engines. Initially, cold-flow simulations were carried out to verify the validity of the computed flow-field and turbulent distribution at ignition time. Then, the combustion process is simulated accounting for the effects of different engine speeds, air/fuel ratio and spark-plug position.

Finally, we thank all the authors and referees for their excellent contributions to this special volume. We also express our gratitude to Helen Gray and Lucy from the Taylor & Francis Group for their continuous support in preparing this special issue.

Matthias Ehrhardt
University of Wuppertal, Germany
Email: ehrhardt@math.uni-wuppertal.de

Lucas Jódar Sánchez
Universitat Politècnica de Valencia, Spain
Email: ljodar@mat.upv.es

Rafael Jacinto Villanueva Micó
Universitat Politècnica de Valencia, Spain
Email: rjvillan@imm.upv.es

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