Editorial

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Biographical note: Viorel Badescu is a Professor in the Department of Engineering Thermodynamics. His mainstream scientific contributions consist of about 200 papers and several books related to statistical physics, thermodynamics, the physics of semiconductors, various aspects of terrestrial and space solar energy applications and other energy related issues. Also, he has theorised on the present-day Mars-meteorology and -terraforming and on several macro-engineering projects. He received four awards among which the Romanian Academy Prize for Physics in 1979.

The most efficient usage of the energy resources has been challenging both in the energy industry and academia for more than 200 years. It is often difficult or impossible to experiment with the real large-scale or expensive energy production systems, to determine improved or optimal solutions. Also, analytical models of energy technology problems can only partially explain and solve real-world problems and usually, this is achieved only with significant simplifications to the models, which make them less representative in practical cases. However, with the impressive progress in computing technology, Computational Fluid Dynamics (CFD) simulation has been widely used in the recent years to model and solve energy related problems. Advanced simulation modelling techniques such as the finite element or boundary element methods have been developed and widely employed in the analysis of energy processes. Applications of CFD simulation vary widely and present a fascinating range of scenarios and techniques.

This special issue of the *International Journal of Energy Technology and Policy* is intended to present recent development and applications of CFD simulation in energy related studies. The eleven selected papers cover a broad spectrum of areas, such as energy technologies and processes associated to thermal power plant operation, renewable energy technologies, energy system analysis, energy efficiency and energy saving (applications and implications), integrated design, as well as energy transmission and distribution issues. The main scope of all these papers is to show how CFD may be used to solve various types of real-world energy problems. CFD simulation methodologies and case studies in the application of simulations are also a part of the work.

A short presentation of the papers included in this special issue follows.

- Dragos Isvoranu in his paper

  "NO_x re-burn simulation in a double-jet counter-flow flame."

presents a potential method for NO_x species reduction based on exhaust gas re-burn with air–fuel mixture in a double-jet counter diffusion flame. The most interesting outcome of the research is that NO emission index has a minimum value of depending upon the equivalence ratio of the air–methane mixture.

- Hideo Kawahara and Tatsuo Nishimura in their paper

  "Vortex structure and heat transfer in a diffusion combustion field with circulating flow."

performed a numerical study to examine the vortical structures for combusting flow from a 2D bluff-body slot burner in the transitional recirculating flow. As a result of the study, it was possible to reproduce the dynamic motions of vortical structures. In the low Reynolds number region, vortex structures in the recirculating region gives large effect in the flame shape. In addition, it was confirmed that independently of the fuel variety, the flow at the bluff-body aft comes into three shape varieties.

- Dorin Stanciu and Mircea Marinescu in their paper

  "RANS Based Numerical Simulation of External Heat Convection and Losses for Transitional Subsonic Flows through a 2D Turbine Passage."

proved that CFD became an indispensable tool for turbomachinery applications. The necessity of efficiency rising requires the development of turbulence and loss models able to correctly predict the performances of transitional fluid flow and heat transfer processes through high turning turbine blades. The paper analyses the behaviour of the most advanced eddy diffusivity turbulence closure model to simulate these kinds of flows and propose a new model of loss evaluation based on the second law of thermodynamics. The model, which uses the volumetric rate of entropy generation as a loss measure, has the advantage of locally revealing the exergy dissipations in every peculiar zone of the flow, like boundary layer, wake, recirculation bubble zone, etc.

- Gabriel P. Negreanu in his paper

  "Numerical simulation of a large power steam turbine run-up."

presents a differential approach of the fluid dynamic processes occurring in the flow path of a large power steam turbine during run-up period. The simulation is performed by the numerical integration of ordinary differential equations obtained by applying the laws of mass and energy conservation in turbine's internal cavities. In this manner, the turbine power and rotor speed vs. time function of the aperture law of the start-up valve have been obtained.

- C. Luca Iandoli, Enrico Sciubba and Nicola Zeoli in their paper

  "The computation of the entropy generation rate for turbomachinery design applications: some theoretical remarks and practical examples."

present a rather complete and accurate, albeit general, analysis of the importance of the local entropy generation maps for turbomachinery applications. The authors argue that the information provided by the separate calculation of the viscous and thermal components of the entropy generation provide designers with an invaluable additional insight into the flow phenomena and on the related irreversibilities. A detailed theoretical discussion is presented, with some preliminary remarks on the approximations introduced

by the turbulence models. Several examples of CFD calculations of the entropy generation in realistic 2- and 3D turbomachinery stages are presented and discussed.

- Triwahju Hardianto, Nobuomi Sakamoto and Nobuhiro Harada in their paper

  "Computational study of a diagonal channel magnetohydrodynamic power generation."

study the performance of a diagonal conducting wall channel Magnetohydrodynamic (MHD) power generation. As a model, the authors are using a scramjet-driven MHD generator channel. It is found that the combustion efficiency of 95% yields a better power generation than 85 and 75% combustion efficiencies.

- Alexandru M. Morega et al. in their paper

  "A Finite Element Method Analysis and Optimization of a Polymer Electrolyte Membrane Fuel Cell with Interdigitated Flow Field Design."

show that Interdigitated Polymer Electrolyte Fuel Cells are particularly attractive due to the enhanced transport rates and benefits with respect to electrode flooding. A 2D isothermal finite element model is used to simulate the outlining processes that occur at the elemental fuel cell level, and to identify potential design enhancement opportunities. The authors outlined an optimal size of the elemental gas channel inlet/outlet width, for fixed elemental cell height, such that the total electrical power of the elemental cell (hence, the total cell/stack electrical power) is maximised, under a constant pressure drop constraint.

- Radu D. Rugescu in his paper

  "Technology of CFD in space engines and solar-gravity draught power plants."

presents the original unsteady numerical code TRANSIT as well as the first results of the flow simulation of a starting transient in the gravitational draught tower WINNDER for aero-acoustic experiments. First, developed to calculate starting transients in rocket engines, TRANSIT 1D method also covers the non-isentropic and discontinuous flow regions with high and equal accuracy within tall gravity draught solar towers. The fresh air in the WINNDER tunnel is heated through a new system of solar mirror arrays and numerical simulations show an unexpected stepwise initial acceleration of the air along this tower, despite the continuous variation of the air temperature itself.

- T. Kousksou et al. in their paper

  "Numerical simulation of fluid flow and heat transfer in a phase change thermal energy storage"

studied an industrial process of energy storage. The authors developed a 2D numerical model. They used a porous medium approach and considered the super-cooling phenomenon. The system consists of a cylindrical tank filled with encapsulated liquid–solid Phase Change Materials. The effects of different parameters on the behaviour of the tank, such as capsule size, porosity of the packed capsules and the tank dimension were examined when the tank is in horizontal position.

- Milorad Bojic, Slobodan Savic and Danijela Nikolic in their paper

  "Application of CFD to flow next to high-rise buildings in Hong Kong due to air-conditioner heat rejection"

review CFD studies of flow field and temperature next to high-rise residential buildings. This flow field, established by a number of window air-conditioners that reject condenser heat into their recessed spaces, is investigated by using FLUENT 5.0 and k–ε turbulence model. The research is performed for different high-rise buildings with different condenser-unit locations.

- Kaveh Sookhak Lari in his paper

  "Thermal Energy Flow Modelling in a Typical University Classroom"

shows that despite the low energy price in Iran, saving energy policies are important in several fields such as buildings, transportation and public issues. As an applied project, the Isfahan University of Technology decided to evaluate existing energy consumption situation of the campus buildings. As a part of this project, the author simulated thermal energy flow in a typical classroom and suggested some modifications to improve the efficiency.

A critical part of writing any good work is the review process, and the authors and the Guest Editor are very much obliged to the researchers who patiently helped them to read through subsequent articles and who made valuable suggestions:

Prof. Samim Anghaie (Innovative Nuclear Space Power and Propulsion Institute, Gainesville, USA), Dr. Tunde Bello-Ochende (University of Pretoria, South Africa), Prof. Paul Cizmas (Texas A&M University, USA), Prof. Valeriu Dulgheru (Technical University, Chisinau, Moldova), Dr. Bernard Guy (European Centre for Advanced Studies in Thermodynamics, Saint-Etienne, France), Prof. K.A.R. Ismail (Universidade Estadual de Campinas, Brazil), Dr. Mohammed Lachi (Université de Reims, France), Prof. Marcello Manna (Universita' degli Studi di Napoli 'Federico II', Italy), Prof. Josua P. Meyer (University of Pretoria, South Africa), Prof. Tanase Panait (University 'Dunarea de Jos' of Galati, Romania), Dr. Velimir Stefanovic (University of Nis, Serbia), Prof. Evgeny Pavlovich Velikhov (Russian Research Centre Kurchatov Institute, Moscow, Russia).

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