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Editorial

Special Issue on the Advances in Fluid Mechanics

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The progressive implementation of computational fluid dynamics (CFD) has experienced a great increase over the last decades as its use has become more feasible worldwide. The goal of turbulence modeling is to reproduce these flow physics as accurately as possible with a reasonable computational effort. In some cases, turbulence is modeled by the Reynolds Averaged Navier–Stokes (RANS) methods, where the ensemble averaging tends to remove the unsteady part. RANS models generally perform satisfactorily in less complex flows, whereas, in more complex scenarios, it may result in an unsatisfactory performance. A completely different approach is represented by the so-called large eddy simulation (LES) method, where the large-scale energy-containing eddies are solved directly, while the effects of smaller-scale eddies are simply modeled, resulting in more expensive models than RANS models in terms of computational cost, but results in a remarkable increasing regarding the accuracy of the predictions. In this Special Issue, a total of 11 papers have been published, focused on different disciplines of fluid mechanics, showing the latest advances in each field.

Considering the above, this Special Issue was introduced to collect the latest research addressing the present challenges in fluid mechanics. There were 12 papers submitted to this Special Issue, and 11 papers were accepted (i.e., a 91.6% acceptance rate). When looking back to the papers, various topics have been addressed, mainly based on numerical modelling applied to different approaches, such as turbomachinery, airfoils, offshore renewables, drainage, and other completely different applications from heat transfer and PIV measurement techniques to hot gases and plasmas.

There are three papers focused on rotational machines. The first one, authored by Li, X. et al. [1], presents flow control effects over the geometry of the end wall surface of axial compressors that illustrates the possible variation of end wall flow according to the Bernoulli effect. In the circumferential direction, the full-area unit generates an upslope surface, whereas, on the pressure side of the end wall, all side effects are contrary to the suction side. The second paper, authored by Tan, L. et al., provides another review on the effect of blade wrap angle on the hydrodynamic radial force of a single blade centrifugal pump [2] through numerical simulation because the dissipation losses show a decreasing trend as the blade wrap angle increases, suggesting that the available blade wrap angle for the pump should be in a well-defined angle, to achieve a better hydraulic performance and stable flow field. Finally, in the third paper, Bengoechea, A. et al. [3] presented an approach to the flow pattern of axial fans via a compact model based on three directional pressure loss coefficients comparing several flow patterns obtained through different modeling strategies, highlighting a porous media; thus, a significant reduction in the time needed to create the mesh as it is not necessary to generate the geometries of the pores, being a great advantage.

Additionally, there are another three papers focused on different types of measurements and heat transfer techniques. The first one by Kotšmíd, S. et al. [4] introduced a theoretical analysis of heat transfer in a heated tube bank, providing the most suitable variant for a unique reference temperature in terms of a constant value for all tube angles and several Reynolds number ranges, which are in good agreement with the most frequently

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used correlating equations. In the second paper, authored by Yazdi, S.G. et al. [5], particle image velocimetry (PIV) was used to capture the fluid dynamics and velocity reduction within silicone aneurysm replicas. A circulatory mimicking loop was developed to pump the flow through the silicone models. While wall shear stress is an important parameter in the analysis of aneurysm flow diversion effects, it was not calculated in this study due to light reflection at the lumen wall that may lead to error in the cross-correlation algorithm, whereas CFD analysis will be implemented soon in three dimensions and high resolution. Finally, the third paper, authored by Basarab, M. et al. [6], presents a novel approach for solving CFD problems in the thermal accelerometer's cavity, which is based on the combined use of Rvachev's R-functions method and the Galerkin technique. Different bases were applied in this work, both spectral (polynomial) and local (B-splines), and good results were achieved for fields evaluated in domains of simple geometry without localized inhomogeneities.

Two additional papers were focused on special fluids, such as plasmas and hot gases. The first one, authored by Regodón, G. et al. [7], highlighted the validity of the orbital theories that model the ion current collected by a cylindrical Langmuir probe immersed in low-pressure, low-temperature helium plasma. Therefore, a transition from the validity of the orbital theories towards the radial theories is expected, depending on the experimental conditions of the plasma. Tang, W. et al., in their paper "Performance and Modeling of a Two-Stage Light Gas Gun Driven by Gaseous Detonation" [8], addressed a two-stage light gas gun driven by gaseous detonation. This type of model is required because different tests are frequently conducted in experimental facilities, and high-quality simulations are needed. The proposed quasi-one-dimensional model provides accurate simulation results of the internal ballistic process of the light-gas gun.

Song, Y. et al. authored the paper "Development of Driftwood Capture Trellis for Capturing Driftwood in Agricultural Drainage Ditches" [9], dealing with driftwood capture trellis for agricultural drainage ditches, contributing to a reduction in overflow damage caused by driftwood sedimentation evaluated the performance of the system through hydraulic experiments, which will be useful in mitigating overflow damage by capturing driftwood in agricultural drainage ditches before it flows into the drainage.

As an emerging renewable energy technology, there is intensive research on wave/marine energy, but more should come. In this Special Issue, a paper put the focus on this technology, authored by Galera-Calero, L. et al. [10], where a detailed study is undertaken with the computational modelling of a sub-platform for floating offshore wind using the software Star-CCM+ with the application of the RANS approach that allowed to reduce the computational cost of each simulation by 50%. The model developed in this paper can be adopted for further study in wave energy.

Lastly, the paper 'Numerical Simulation of Random Cavitation Suppression Based on Variable NACA Airfoils' [11] introduces a deformable covering in the cavitation-prone area of a particular airfoil, which can be changed adaptively to meet the requirement of suppressing random cavitation. The paper was authored by Shi, W. et al., where authors first highlight the challenges for the commonly used Smagorinsky model of the large Eddy simulation (LES) method and the cavitation model of the viscosity-modified model, which can accurately predict the cavitation shedding frequency at the wake of the hydrofoil (which is the main cause of cavitation shedding).

Different examples of the application of the latest advances of Fluid Mechanics have been addressed in this Special Issue, highlighting the true relevance of such improvements in many relevant fields through a common bond, represented here by the implementation of the computational fluid dynamic techniques capable of simulating very complex situations that otherwise would have been impossible both to visualize and to obtain verifiable results. The future of these techniques is very promising as, in fact, most of the pre-conceptual industrial designs nowadays cannot be conceived without the application of such advanced techniques.

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