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Editorial

Symmetry in Fluid Flow II

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Fluid flows sometimes exhibit symmetricity under certain conditions. However, such a symmetric flow is not always realized if such conditions are changed. For example, the plane Poiseuille flow, which exhibits a parabolic velocity profile formed between two parallel walls, has an exact symmetric solution of the Navier–Stokes equation, but its symmetricity breaks under the condition of a high Reynolds number. This kind of flow transition from a steady symmetric state to another more complex state is not only realized in fluid flow experiments or analyses but also observed in natural fluid flow phenomena. The breaks of flow symmetry have been studied theoretically, experimentally, and numerically in the fields of fluid mechanics and thermal engineering because of their importance and relevance in terms of flow control and heat transfer enhancement. However, breaks of flow symmetry have not been sufficiently elucidated due to the non-linear characteristics of fluid flow. The Special Issue focuses on breaks of flow symmetry due to various kinds of factors such as shear, buoyancy, centrifugal force, and surface tension.

As a matter of fact, 11 papers were published in the Special Issue "Symmetry in Fluid Flow II". They can be roughly classified into several topics: detection of multiphase fluids [1,2], drag reduction and laminarization [3,4], channel flow with sudden expanded section and reattachment [5,6], magnetohydrodynamics [7], inclined drop equipped with fishway elements [8], shock wave and discontinuity [9], planar laminar flow [10], and natural convection and its stability [11]. Following is a brief summary of each classified topic.

Roshani et al. [1] evaluated the feasibility of using an X-ray tube instead of radioisotope sources for measuring volume fractions of gas, oil, and water in two typical flow regimes of three-phase flows, namely, annular and stratified. The obtained results indicated that a simple system based on an X-ray tube and just one NaI (sodium iodide) detector could be a potential alternative to radioisotope-based systems for separate measurements of gas, oil, and water volume fractions in annular and stratified flow regimes of a three-phase flow. Alamoudi et al. [2] proposed a novel approach for estimating the scale thickness in pipes in which two-phase flows with different flow patterns and void fractions exist. The results showed the proposed system can be adopted in the petroleum industry for measuring scale thickness in pipes.

Kobayashi et al. [3] investigated the flow properties of water alone, mixed microbubble water, anionic surfactant solution, and polymer solution in capillaries with inner diameters of 750, 490, and 110 μm. It was considered that the pseudo-laminarization of the polymer solution was caused by elasticity whereas that of the microbubble water and the anionic surfactant solution was caused by the solid–liquid interface due to electrical interaction. Diniz et al. [4] investigated the phenomenon of drag reduction on surfaces made of Sylgard 184 elastomer and modified by low-pressure plasma treatments. The obtained superhydrophobic surfaces showed lower resistance to flow, tested by the imposition of flow in channels.

Teso-Fz-Betoño et al. [5] calculated a water reattachment length based on Unsteady Reynolds-Averaged Navier–Stokes (URANS) k-omega with Shear Stress Transport (SST)

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and a Large Eddy Simulation (LES) with Wall-Adapting Local Eddy-Viscosity (WALE). It was concluded that the LES-WALE had more speed variance than the RANS model. Masuda and Tagawa [6] investigated the influence of asymmetry of a channel for cases where the expansion ratio is two and the Reynolds number is less than four hundred. The results exhibited that the pressure drop coefficient is proportional to the power of the Reynolds number and increases with eccentricity S.

Yahalom [7] showed that stationary non-barotropic magnetohydrodynamics can be derived from a variational principle of three functions for both stationary and static cases.

Daneshfaraz et al. [8] investigated hydraulic parameters on an inclined drop equipped with fishway elements, and they provided a way to increase the energy dissipation of flow in the inclined drop with environmental and economic considerations. The results showed that in all experimental models, with increasing the relative critical depth parameter, the energy dissipation values increase, and the downstream Froude number decreases.

Mellmann and Scholle [9] attempted to derive the Rankine–Hugoniot conditions from the symmetries of the Lagrangian. At first, the mathematical derivation of an extended Noether theorem considering discontinuities was derived. In the second step, the general theory was applied to the viscous flow theory.

Daidzic [10] presented a general unified solution of the plane Couette–Poiseuille–Stokes–Womersley incompressible linear fluid flow in a slit in the presence of oscillatory pressure gradients with periodic synchronous vibrating boundaries. The eigenfunction expansion method was used to solve the global non-homogeneous linear initial and boundary value problem analytically. Simultaneously, a finite-volume method was used for the numerical experiment.

Satake and Tagawa [11] numerically studied thermal convection in a rotating spherical shell by incorporating the effect of centrifugal buoyancy by using both three-dimensional numerical simulations and linear stability analyses. It was reported that axisymmetric flow tends to be maintained as the effect of centrifugal buoyancy increases.

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Conflicts of Interest: The author declares no conflict of interest.

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