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Editorial

Editorial for Special Issue "Multiscale Turbulent Transport"

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Turbulent transport is currently a great subject of ongoing investigation at the interface of methodologies running from theory to numerical simulations and experiments, and covering several spatio-temporal scales. Mathematical analysis, physical modelling and engineering applications represent different facets of a classical, long-standing problem still far from achieving a thorough comprehension. The goal of this Special Issue was to offer recent advances covering subjects such as multiscale analysis in turbulent transport processes, Lagrangian and Eulerian descriptions of turbulence, advection of particles and fields in turbulent flows, ideal or non-ideal turbulence (unstationary/inhomogeneous/anisotropic/compressible), turbulent flows in bio-fluid mechanics and magnetohydrodynamics, control and optimization of turbulent transport. The Special Issue was open to regular articles, review papers focused on the state-of-the-art and the progress made over the last few years, as well as new research trends.

Yamanaka et al. (2018) [1] focused on weak defect turbulence in the electroconvection of nematic liquid crystals, from the experimental point of view. Increasing the coarse-graining time, the authors showed that the type of diffusion changes from superdiffusion first to subdiffusion and then to the standard diffusive behaviour, a result reflecting the coexistence of local order and global disorder in the analysis of convective rolls.

Martins Afonso et al. (2019) [2], in the background of linear-stability analysis, passive optimal control and structural sensitivity, investigated the incompressible fluid flow past a backward-slanted step inclined at 25 degrees, which represents a portion of the well-known Ahmed's body mimicking a simplified ground-vehicle geometry of the bluff-body type (such as the rear window of a car). Since this section is responsible for the majority of the aerodynamic drag—due to the unfavourable pressure gradient caused by the recirculation bubble before the reattachment—they studied how to reduce or delay the flow separation, exploiting adjoint-state method, variational formalism, penalization scheme, orthogonalization algorithm and functional derivatives.

Locke et al. (2019) [3] theoretically discussed the B-model for turbulence intermittency, first by pointing out a couple of mistakes in the original derivation and analyzing the corrected results in terms of a set of coefficients, and then by generalizing it and comparing such an extension with experimental findings from a unidirectional oval flume and with other discrete/continuous breakage/cascade models.

Rahman and San (2019) [4] concentrated their attention on the performance of a relaxation filtering approach for Euler turbulence using a central seven-point stencil reconstruction scheme. Two-dimensional inviscid Rayleigh–Taylor instability provided the benchmark for the assessment of high-resolution numerical simulations, for both the time evolution of the flow field and its spectral resolution up to three decades of inertial range.

Araya (2019) [5] explored the performance of several turbulence models for the Reynolds-Averaged Numerical Simulation of steady compressible turbulent flows on complex geometries and unstructured grids. Validation against high-resolution Direct Numerical Simulations and previous experimental data was followed by an application to a few aerodynamic profiles, the main discriminant for the accuracy being the attached or separated character of the velocity field.

Lees and Aluie (2019) [6] underlined the role of baroclinicity (misalignment of pressure and density gradients) in the kinetic-energy budget, by means of coarse graining and scale decomposition. The role of baropycnal work was stressed by successfully comparing an analytical model developed here with on-purpose numerical simulations of compressible turbulence, highlighting the importance of this contributions in the generation of vorticity and strain as well.

Gama et al. (2019) [7] dealt with Padé approximations of the magnetohydrodynamic kinematic dynamo α-effect and of the eddy-viscosity or diffusivity tensors in different flows, employing expressions derived in the framework of the multiple-scale formalism. They performed computations in Fortran in the standard "double" (real*8) and extended "quadruple" (real*16) precision, as well as symbolic calculations in Mathematica.

Bhowmick and Iovieno (2019) [8] simulated the transient evolution of a turbulent cloud top interface, using a pseudo-spectral Direct Numerical Simulation along with Lagrangian droplet equations including collision and coalescence. Clear-air entrainment/detrainment and turbulent mixing are known to affect the droplet spectrum through supersaturation fluctuations, and the effects of collisions—driven by gravitational sedimentation—and condensation/evaporation on the radius distribution were estimated.

López Castaño et al. (2019) [9] tested two algorithms for the temporal integration of the Navier—Stokes equations in the Boussinesq approximation for turbulent flows, within the Large-Eddy Simulation methodology and the OpenFOAM implementation with hexahedral meshes. They proved the validity of an anisotropic filter function, and demonstrated the superiority of a specific method via studies of a wall-bounded channel flow and of Rayleigh—Bénard convection.

Conflicts of Interest: The authors declare no conflict of interest.

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