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Book Review: **Homogenous Turbulence Dynamics**, Pierre Sagaut and Claude Cambon, Springer International Publishing, 2018, 897 pages.

Turbulence is an inspirational phenomenon. How a laminar flow structure turns into a chaotic "unpredictable" flow motion or reorganizes itself to origin coherent patterns has caught the attention to both artists and scientists. Like the sparkling flame in a bonfire, the visual beauty of the turbulent structures fascinated and encouraged artists to portray their own personal interpretation on the canvas. Outstanding examples can be found in Leonardo da Vinci's whirlpool sketches, as well as the self-similar water spikes in *The Great Wave* by Katsushika Hokusai or the eddies in *The Starry Night* by Vincent van Gogh. Likewise, many scientists get captivated by turbulence, not only by its external appearance, but also by the puzzling physics that governs the flow field. They promptly realize that turbulence is, in fact, a very rich phenomenon that does not admit a unique interpretation, nor does it manifest in a single form. This characteristic, along with its high applicability, has made turbulence one of the most studied problems in physics and engineering, with the amount of technical publications counting in thousands. It is on this super-populated topics where books like the one presented by Pierre Sagaut and Claude Cambon, *Homogenous Turbulence Dynamics*, make real sense. The effort put in selecting, organizing, and unifying the overwhelming literature accumulated on homogenous turbulence will be highly appreciated by the qualified reader. If, in addition, a wise personal viewpoint is employed in analyzing the different models and theories published so far, the value of the work multiplies.

Certainly, this is not intended to be an introductory text on turbulence. Anyone interested in doing a first contact on the topic is advised to begin with a more pedagogically-orientated text. Some fundamental references of this type might be the books by Batchelor [1] and Tennekes *et al.* [2], as well as Refs.[3–6]. For sure, *Homogenous Turbulence Dynamics* has not been thought to substitute any of these references, but rather to complement them with state-of-the-art publications. Since some notion of turbulence is pre-requisite to fully profit the book, the potential audience is somewhat delineated: researchers and engineers that are familiar with turbulence and that look for an excellent guide of articles on the topic, which ranges from pioneering classical references to up-to-the-minute scientific findings. However, *Homogenous Turbulence Dynamics* goes further beyond being a *compendium* of publications. The authors interpret the models, prioritize results, and suggest pathways to address non-trivial turbulent configurations, with the wide experience gathered by P. Sagaut and C. Cambon, from both numerical and theoretical approaches, being recognized throughout the text.

As most of the topics in fluid dynamics, turbulence is a polyhedral phenomenon that can be addressed from theoretical, numerical or experimental techniques. Each of which can be specifically designed to investigate distinguished features: whether flow homogeneity evolves in time, the role of tridimensional effects, the importance of non-linear fluctuations, the contribution of the different scales, among many others. However, I personally like the election made by the authors in the first-level organization of the book, making a clear distinction between incompressible/compressible and anisotropic/isotropic turbulence. If put into a two-axis chart, with the abscissa representing compressibility from left to right, and the ordinate quantifying isotropy from bottom to top, the reader would find that all contents are fairly well represented, with the

corner close to the origin, dedicated to incompressible anisotropic turbulence, standing out from the rest. Thus, advanced readers could easily move over the chart anticipating the effects that wants to investigate, and, on their path, they will find the latest theories and models in the literature. As in the previous edition, the book also contains an extra dimension representing the level of details, so that tricky derivations can be skipped, if wished.

This second edition, which practically doubles in length its previous version, comprises eighteen chapters grouped into five different blocks, excluding the introduction chapter. Chapters two and three form the first block and contain the general governing equations, written for both incompressible and compressible flows, respectively, and particularized to turbulent flows. The next block is made of three chapters and it is devoted to incompressible isotropic turbulence, with the chapter four being dedicated to lay the foundations of homogenous turbulence for newtonian fluids. Particularization to viscoelastic and quantum turbulence is deeply discussed in the following chapters five and six. Without belittling other blocks, the next one dedicated to incompressible anisotropic turbulence is particularly interesting, as the own experience gained by the author is manifest in the analysis of the themes covered. This block contains six chapters that address anisotropy induced by different effects, including rotation, strain, shear, stratification, coupling between them, and magneto-hydrodynamics, respectively. The effect of compressibility is left to the next three-chapter block. Isotropic compressible turbulence is shown first, while anisotropy is later analyzed through the effects of shear and directional stresses. The latter is extended, in the third chapter of this block, to sudden compressions that yield the canonical shock/turbulence interaction problem. The final block extends previous chapters with advanced modeling techniques, where, for instance, linear and non-linear models are presented and discussed in chapters sixteen and seventeen. The text closes up with the concluding chapter, where some personal perspectives are stated.

In summary, I frankly recommend this monograph to anyone who wants to delve into the latest outcomes in turbulence theory. It will be specially useful for research groups involved in fluid dynamics research, with special emphasis on the aeronautical community. As for myself, I have already saved a hand-reachable spot for *Homogenous Turbulence Dynamics* on my desk.

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