

Editorial

Research to Break Through the Turbulence Mechanism Requires Bolder Innovation

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1. How I Was Attracted by Fluid Mechanics Problems

The founding of the International Journal of Turbulence Explorations (IJTE) is rooted in my personal research trajectory. It has been exactly 40 years since I began my master's degree in 1987, and my scholarly focus has primarily been on thermal radiation analysis, combustion monitoring, and intelligent power generation (<https://orcid.org/my-orcid?orcid=0000-0003-4900-6609> (accessed on 29 September 2026)). During this period, the fluid mechanical phenomenon that left the deepest impression on me was tropical cyclones. Around the 1990s (I can't remember the exact year), I vividly recall a typhoon that made landfall along the coasts of Fujian and Zhejiang Provinces, in China, while I was studying and working at Huazhong University of Science and Technology in Wuhan. Although Wuhan is located deep inland—nearly a thousand kilometers from the coastline—the storm still produced gale-force winds reaching Beaufort scale 12. That night, I remained in my dormitory, sensing as though the building might be toppled by the immense wind power. The following morning, I found dead sparrows strewn across the ground. When a strong wind comes, sparrows will naturally take cover, but when all the hiding spots they choose are invaded by the strong wind, they have nowhere to hide. After this experience, a question has been lingering in my mind: The kinetic energy carried by a typhoon, which can span nearly a thousand kilometers from inland regions to the coastline, must be immense, but to what extent can it reach?

In July–August 2006, I attended the 31st International Symposium on Combustion in Heidelberg, Germany. In my hotel room, I came across the August 2006 issue of *National Geographic*, whose cover featured a striking image of a tropical cyclone. The issue commemorated the anniversary of Hurricane Katrina, which struck the United States in 2005 and caused catastrophic losses. One sentence in the article immediately captured my attention:

“Even an average hurricane packs some 1.5 trillion watts of power in its winds, equivalent to about half the world's entire electrical generating capacity.”

This vivid quantification affirmed my earlier intuition regarding the immense power of typhoons. From an energy utilization perspective, tropical cyclones represent not only a massive waste of atmospheric kinetic energy but also a persistent threat to life and property. As a researcher in power engineering and engineering thermophysics, I am increasingly aware of the scientific significance and the societal urgency of turbulence research. Turbulence, as one of the most formidable challenges in classical physics, therefore offers profound research value across scientific, engineering, and socioeconomic dimensions [1–5].

Through years of observation and reflection, I became increasingly convinced that fluid flow—particularly turbulence—constitutes a foundational problem across multiple fields, including aerospace,



marine engineering, atmospheric science, energy systems, biomedical flows, and beyond. From 2019 to 2020, I made a deliberate decision to reorient my research focus toward fundamental fluid mechanics, with the hope that by the time I retire in roughly a decade, I might contribute some insights into turbulence mechanisms. Five years into this endeavor, I am encouraged by the progress achieved thus far, which has far exceeded my initial expectations.

2. My Research Experience on Fluid Mechanics

Once a velocity gradient exists in a viscous flow—such as across a shock wave—both viscous forces and viscous energy dissipation arise within the flow field according to the Navier-Stokes framework. However, this conventional formulation can obscure the distinct contributions of compressibility and viscosity. Let us introduce this issue by citing the works of H.-S. Tsien [6]. When estimating shock wave thickness, it is necessary to calculate the viscous stress, obtained by multiplying the velocity gradient by the viscosity coefficient. The velocity gradient is derived from the difference in velocity before and after the shock wave, and is divided by the shock wave thickness [6]. At this point, the author left the following text in the manuscript: Generally, when there is a velocity gradient perpendicular to the direction of flow, viscosity comes into play. What role does viscosity play in situations far from the boundary, where one must resort to gas kinetic theory [6]? This indicates that H.-S. Tsien had doubts about calculating viscous stress in this way. In my first paper on fundamental fluid mechanics [7], I introduced a viscous shear vector, defined as the component of velocity magnitude gradient perpendicular to the velocity vector. Building on this definition, a viscous energy flux vector was constructed by multiplying the viscous shear vector by the dynamic viscosity and the magnitude of the velocity. The divergence of this flux vector yields new expressions for viscous force and viscous energy loss, in which all the square terms of velocity derivatives correspond to irreversible dissipation, while the remaining terms represent mechanical energy transfer by viscous forces. Under the assumption that the viscous force vector is parallel to the velocity vector, the viscous force components can be explicitly derived. These new equations differ from and are more elaborate than the classical Navier-Stokes formulations. Notably, this framework predicts that no shear viscous force or shear viscous energy loss may exist in the flow across a normal shock wave in the absence of velocity gradient perpendicular to the flow direction.

According to this new model, one-dimensional flows—characterized by a single velocity component with varying magnitude—may exhibit no viscous effects before and after a normal shock wave. This inference is consistent with conclusions drawn by Professor Hongyi Xu of Fudan University, who formulated the motion equation [8] based on the Liutex vortex identification theory established by Professor Chaoqun Liu [9].

To further investigate how the pressure difference force and viscous forces balance in pressure-driven pipe flows, my group conducted a detailed study on the shape and force flow distribution of capillary menisci in cylindrical tubes [10]. We introduced telecentric imaging technology to accurately capture meniscus contours and, based on Snell's law, derived an optical inversion model to correct radial distortions caused by refractive index mismatches. Static capillary rise experiments were performed using water, ethanol, and glycerol in eight capillary tubes with inner diameters ranging from 0.84 to 5.05 mm. The corrected meniscus contour profiles were fitted using parabolic, catenary, and circular-arc functions. The results consistently demonstrated that circular-arc curves provided significantly higher fitting accuracy than parabolic or catenary models, indicating that capillary menisci in circular tubes closely approximate spherical surfaces with a single radius of curvature.

This finding prompted a further analogy with structural mechanics, where membrane theory has long been employed to analyze thin-shell structures [11]. We speculated that the thin liquid layer beneath a capillary meniscus behaves analogously to a spherical shell; rather than being a narrowly defined “surface force” in the traditional fluid-mechanical sense, surface tension may be reinterpreted as the tangential

tensile stress acting on internal cross-sections of the underlying liquid layer [10]. This perspective offers a complementary mechanical interpretation of capillary phenomena and motivates further exploration of stress transmission in fluid mechanics.

3. Why a New Journal on Turbulence Is Needed

Turbulence remains a central unsolved problem in fundamental physics and engineering. Despite more than a century of sustained research, a comprehensive theoretical framework continues to elude the scientific community, keeping turbulence at the forefront of fluid mechanics, physics, and mathematics. A definitive resolution to this problem may require new concepts, methodologies, and research paradigms.

At present, the majority of turbulence research still adheres to conventional theoretical frameworks. While these approaches have yielded valuable insights, they have yet to deliver a breakthrough in understanding the core mechanisms of turbulence. Moreover, revising or extending physical theories that have been established for nearly two centuries cannot be accomplished through one or two isolated publications. It is unrealistic to expect a single paper to present a complete, experimentally validated, and fully consistent new theory.

Yet, unconventional ideas—however promising—often struggle to find a venue in mainstream journals, which tend to prioritize incremental advances within accepted paradigms. This creates an urgent need for a dedicated platform that actively encourages intellectual diversity and bold innovation in turbulence research. IJTE is conceived precisely to fill this gap.

4. How IJTE Differs from Existing Journals

IJTE distinguishes itself by prioritizing originality and conceptual novelty in turbulence research. The journal welcomes contributions that explore, but are not limited to:

- Governing equations of turbulence and their mathematical and physical properties
- Stress–strain relationships, constitutive modeling, and continuity assumptions
- Turbulence generation mechanisms, solution regularity, and turbulence onset
- Energy transfer, Cascade theories, intermittency, and dissipation processes
- Coherent structures and singularities

While IJTE focuses on fundamental research, it does not exclude studies grounded in engineering contexts, provided they yield clear physical insight into turbulence phenomena. In contrast to many established journals that predominantly publish work within traditional theoretical frameworks, IJTE emphasizes innovation. Manuscripts that merely reproduce or extend existing methodologies without conceptual advancement are outside the journal's primary scope, unless something that extends the existing methodology and can uncover new insights.

5. Balancing Originality with Scientific Rigor

IJTE values original ideas and theoretical conjectures, even when immediate experimental verification is not yet available. To justify this editorial stance, one may recall a landmark moment in the history of physics. Einstein's 1905 paper on special relativity was, at the time of submission, a theoretical conjecture without experimental confirmation. Yet the editorial board of the *Annalen der Physik*, which included Max Planck, recognized the profound significance of this bold idea and chose to publish it. The work drew little attention for five years. After reading Einstein's paper, Arthur Eddington initiated relevant observational tests five years later. Almost a decade after publication, in 1919, Arthur Eddington's solar eclipse observations confirmed Einstein's predictions, catapulting the theory to worldwide recognition. Had the manuscript been evaluated under today's prevailing demand for immediate empirical validation, it might well have been rejected as speculative or lacking rigorous proof.

IJTE aspires to provide a similar intellectual home for transformative ideas in turbulence research. We hope to publish work that, like Einstein's 1905 contribution to relativity, has the potential to redefine our understanding of turbulence and inspire generations of future research.

Declaration of Competing Interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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