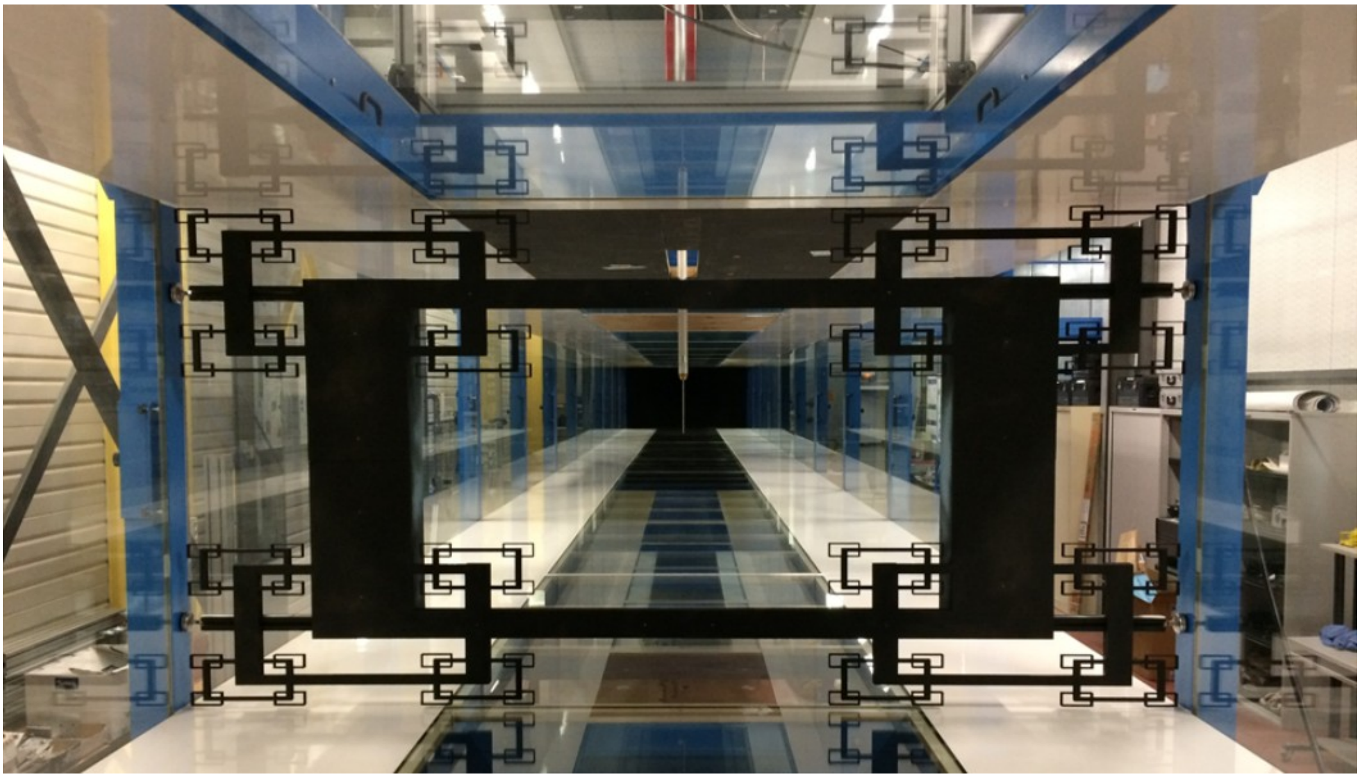
Co-funded by the European Union

LILLE TURBULENCE PROGRAMME 2025

OPENING WORKSHOP ON TURBULENT FLOWS

Villeneuve d'Ascq, Cité Scientifique, M6 Building
17-19 June 2025

https://lmfl.cnrs.fr/workshop/ltp-2025-home/



The aim of this workshop is to discuss approaches to turbulent flows which go beyond Kolmogorov equilibrium cascades by taking explicit account of non-stationarity and/or non-homogeneity either in a statistical sense or in the local sense of dynamic intermittency. Kolmogorov equilibrium describes the spatio-temporal average of statistically homogeneous isotropic turbulence. Non-equilibrium is manifest in fluctuations around this equilibrium either in time for spatial averages or in space for time averages and in deviations from such equilibrium by the presence of statistical non-homogeneity and/or non-stationarity/turbulence decay. Non-equilibrium is therefore present in all turbulent flows which implies that various turbulent energy transfer and/or production mechanisms in both scale and physical spaces need to be taken into account to understand turbulence physics, including turbulence cascades, turbulence dissipation and intermittent fluctuations. Different universality classes of non-equilibrium may need to be defined by considering the presence or absence of different types of large-scale coherent structures and different regions of flows in terms of turbulence production, turbulence transport and proximity to the turbulent/non-turbulent interface which is an extreme but ubiquitous instance of local non-homogeneity/intermittency/near-singularity. There are consequences for important leading order properties of a raft of boundary-free turbulent flows including growth rates of turbulent shear flows such as turbulent wakes, jets and mixing layers where approaches based on momentum and force balances need to be confronted with approaches where turbulent energy balances and therefore turbulence dissipation play a leading role. There are also consequences for wall flows such a turbulent channel flows and various types of turbulent boundary layers which need to be elucidated and where both momentum and energy transfers, as well as wall-blocked coherent structures, are key.

TUESDAY 17 JUNE 2025

12:00-14:30 WELCOME AND LUNCH

14:30-15:10: REMI MANCEAU - The active approach of hybrid RANS/LES modeling for continuous embedded LES.

15:10-15:50: LEONIE CANET – Space-time dependence of correlation functions in different models of turbulence.

15:50-16:30: JEREMIE BEC – Eulerian vs. Lagrangian intermittency in homogeneous isotropic turbulence.

16:30-17:10: TEA/COFFEE BREAK AND DISCUSSIONS

17:10-17:50: CARLOS DA SILVA - Lifetime, birth and death of the intense vorticity structures in isotropic turbulence.

WEDNESDAY 18 JUNE 2025

9:00-9:40 : ANDREW WYNN – To what extent do boundary-layer flows on period domains resemble canonical, spatially evolving, boundary layers?

9:40-10:20: YVES POMEAU – On the drag crisis.

10:20-11:0O: LUC PASTUR – Intermittent and low fequency dynamics of a thin airfoil at stall.

11:00-11:20 : TEA/COFFEE BREAK AND DISCUSSIONS

11:20-12:00: YONGYUN HWANG - Turbulent transport for wall shear stress fluctuations.

12:00-12:40: MAURIZIO QUADRIO - Spanwise forcing for drag reduction, and how to understand it via phase-scale-space statistics.

12:40-14:30 : LUNCH

14:30-15:10: ANDREA CIMARELLI - Split energy cascades in multi-scale injection inhomogeneous anisotropic turbulence.

15:10-15:50: CHRISTOS VASSILICOS – Turbulent diffusion on turbulent cascade.

15:50-16:30: SUTANU SARKAR - Connections between coherent structures and turbulence: examples from geophysical flows.

16:30-17:10 : TEA/COFFEE BREAK AND DISCUSSIONS

17:10-17:50: MARTA WACLAWCZYK – Non-equilibrium turbulence in the Atmospheric Boundary Layer.

20:00: WORKSHOP DINNER AT THE CENTRE OF LILLE

THURSDAY 19 JUNE 2025

9:00-9:40 : SZYMON MALINOWSKI – Small scale temperature fluctuations in free atmosphere

9:40-10:20: ALI KHOJASTEH - Coherent Structures Governing Transport at Turbulent Interfaces

10:20-11:00: NICOLAS BENARD - Active plasma control for sustained large-scale structures in nearly isotropic grid-generated turbulence.

11:00-11:40: COFFEE BREAK

11:40-12:20 : MIKHAEL GOROKHOVSKI – Turbulent cascades and stochastic models of droplets breakup.

12:20-14:00: CLOSING BUFFET LUNCH

The active approach of hybrid RANS/LES modeling for continuous embedded LES

Rémi Manceau

Laboratory of Mathematics and Applied Mathematics (LMAP)

University of Pau & Pays Adour, E2S UPPA, CNRS, INRIA, CAGIRE project-team

Pau, France

In this seminar, recent work on the development of hybrid RANS/LES and enrichment of solutions at the diffuse RANS/LES interface will be presented. Based on a temporal filtering formalism, connections between the Navier-Stokes equations and the modeling of unresolved scales can be established, in particular with regard to the transition between RANS and LES, leading to the HTLES approach. The deficit of resolved turbulent structures (modelled stress depletion) observed after the RANS-to-LES transition zone is linked to a problem of non-conservation of mechanical energy, which can only be solved by introducing an active approach based on volume forcing. This active approach makes it possible to use hybrid RANS/LES in *continuous embedded LES* mode, and to automate resolution refinement by identifying zones according to physical criteria, paving the way for more reliable use of hybrid RANS/LES for applications.

Space-time dependence of correlation functions in different models of turbulence

Leonie Canet
Laboratoire de Physique et Modelisation des millieux condenses
Université Grenoble Alpes
Grenoble, France

Calculating, from first principles, the statistical properties of homogeneous and isotropic fully developed turbulence remains an unsolved issue. The theoretical challenge to overcome is that correlation functions are determined by an infinite hierarchy of coupled dynamical equations which needs to be closed. The functional renormalization group (FRG) offers an interesting theoretical tool to tackle this problem and achieve a controlled closure in the limit of large wavenumbers. I will show how it allows one to obtain analytical results on the space-time dependence of generic multi-point correlation functions of the turbulent velocity in this limit. I will explore different models of turbulence, such as stochastic Euler equations (Forster-Nelson-Stephen model), Kraichnan's model for passive scalar turbulence, or the stochastic Burgers equation, and show that a universal behavior emerges in the temporal decay of correlation functions, and that its origin can be traced down to common underlying extended symmetries which I will discuss. I will also compare these predictions with available results from direct numerical simulations and experiments.

Eulerian vs. Lagrangian intermittency in homogeneous isotropic turbulence

Jeremie Bec
Institut de Physique de Nice (INPHYNI), CNRS, Université Côte d'Azur
Nice, France

Intermittency in turbulence manifests as intense fluctuations in energy dissipation and deviations from classical scaling laws, which can be described within the multifractal cascade framework. While the Eulerian approach characterizes these fluctuations through spatial fields, the Lagrangian perspective captures them along tracer trajectories. These complementary viewpoints call for a unified theoretical framework. In this talk, we examine the statistical signatures of Eulerian and Lagrangian intermittency, emphasizing the role of bridge relations in linking their respective fluctuations. High-resolution numerical simulations suggest that Lagrangian dissipation exhibits more robust and universal fluctuations than its Eulerian counterpart. Furthermore, we discuss how causality constraints, inherent to the Lagrangian description, dictate the temporal evolution of intermittency and ultimately give rise to the observed Eulerian scaling properties.

Lifetime, birth and death of the intense vorticity structures in isotropic turbulence

Carlos da Silva
Instituto Superior Tecnico, Universidade de Lisboa
Lisbon, Portugal

One of the most distinctive characteristics of turbulent flows is the presence of a large range of eddy structures, defined loosely as regions of concentrated vorticity and low pressure, with a life time which is large, compared with the characteristic timescale of the flow, for the biggest of these structures. The smallest existing eddies, where the most intense vorticity of the flow isconcentrated, are usually named the ‘worms’ or the intense vorticity structures (IVS). Their relevance in turbulence is connected with their relation with the viscous dissipation mechanism, internal intermittency, and with small scale mixing, notably to the so-called ’nibbling’ mechanism which ultimately causes the turbulent entrainment.

Recent direct numerical simulations (DNS) have been carried out to revisit and assess the geometry and dynamical features of these structures at much higher Reynolds numbers than previously available. The Burgers vortex model provides a good representation of the radius of the most frequent IVS but the scaling of the tangential velocity exhibits a more complex behaviour, while the length scale of the IVS is shown to scale with the Kolmogorov micro-scale for sufficiently high Reynolds numbers.

An innovative time tracking algorithm is implemented that allows the time tracking of a very large number of IVS, providing the first systematic study of lifetime, ‘birth' and ‘death’ of the IVS. The majority of these structures follows a solitary life with few direct interactions (merging/splitting) with other structures, although the number of ‘branches’ increases with the Reynolds number. The lifetime of the ‘worms' displays an exponential distribution and the mean life time scales with the rotation time scale of the IVS, pointing to a memoryless process. A population model is able to estimate the density of these structures, which slowly increased with the Reynolds number. Finally, the role of the IVS in the turbulent entrainment mechanism known as ’nibbling’ is described.

To what extent do boundary-layer flows on period domains resemble canonical, spatially evolving, boundary layers?

Andrew Wynn
Department of Aeronautics, Imperial College London
London, U.K.

We study a class of boundary-layer-like flows, defined on a periodic domain in the streamwise direction, where a body force maintains a statistically-steady boundary layer thickness. The idea, proposed by Biau in 2023, is that these flows can model a small section of a classical, spatially-evolving, boundary layer at a prescribed Reynolds number. The assumption of periodicity gives significant advantages for both numerical efficiency and theoretical investigation, but the question remains as to the extent to which periodic boundary layers provide good models for spatially-evolving ones. This talk will give some preliminary answers.

We present numerical evidence, from direct numerical simulations up to $Re\theta = 2000$ and implicit large-eddy simulations up to $Re\theta = 8300$, showing that periodic models compare well with data from spatially-evolving boundary layers at equivalent Reynolds numbers. We will present a rigorous upper-bound on skin friction for periodic boundary layer flows, a result which is within a logarithm of empirical observations of spatially-evolving boundary layers. Periodicity is crucial to proving this result which, interestingly, has never yet been proven for classical, spatially evolving, boundary layers. In summary, we present both numerical evidence and theoretical analysis to support the use of periodic flows as simpler models for canonical, spatially-evolving, boundary layers.

On the drag crisis

Y. Pomeau
LadHyX (CNRS UMR 7646), Ecole Polytechnique,
Palaiseau, France

Drag crisis in a fast flow on a sphere is an observation by G. Eiffel remaining unexplained after more than a century. The sharp drop of the turbulent drag is due to a change of shape on the recirculation bubble behind the sphere. This is hard to explain because it occurs at a quite well defined value of the Reynolds number of about half a million and because this is a first order. It points to the existence of equations for the mean flow structure averaged over the turbulent fluctuations and possible bifurcations of their solutions. The sharpness of the transition could be related to probabilistic effects on the fluctuations.

Work done with Martine Le Berre and Serge Mora.

Intermittent and low fequency dynamics of a thin airfoil at stall

Luc Pastur
Institute of Mechanical Sciences and Industrial Applications, ENSTA-Paris,
Institut Polytechnique de Paris
Palaiseau, France

We study experimentally the stall over a thin symmetric airfoil (NACA0012) by means of synchronized PIV-force and pressure measurements. We found a critical Reynolds number from which the flow transitions from a classical low-frequency oscillations regime to random bistable dynamics. In this regime, the flow switches randomly between a high lift state and a low lift state with residence times orders of magnitude larger than any timescale of the flow. We conditioned the PIV fields of both regimes using the lift coefficient signal. The lift-conditioned PIV fields confirm that the high lift state corresponds to a mostly attached flow and the low lift state to a massive separation of the boundary layer. A similar approach was followed for the low frequency regime. The phase averaged flow fields associated with the low frequency oscillations exhibit a cyclic phenomenon located in the upstream bubble of recirculation. Using the time series of force and pressure measurements, we conducted a statistical analysis on the random dynamics, revealing a memoryless process with extreme events.

Turbulent transport for wall shear stress fluctuations

Y. Hwang
Department of Aeronautics, Imperial College London
London,UK

Statistical structure and the underlying energy budget of wall shear stress fluctuations are studied in both Poiseulle and Couette flows with emphasis on its streamwise component. Using a dimensional analysis and direct numerical simulation data, it is shown that the spectra of streamwise wall dissipation for $\lambda \lesssim 1000\delta v$ are asymptotically invariant with the Reynolds number (*Re*), whereas those for $\lambda \gtrsim \delta$ decay with *Re* (here, λ is a nominal wall-parallel wavelength, and δv and δ are the viscous inner and outer length scales, respectively). The wall dissipation increases with *Re* due to the increasing contribution of the spectra at $1000\delta v \lesssim \lambda \lesssim \delta$. The subsequent analysis of the energy budget shows that the near-wall motions associated with these wall dissipation spectra are mainly driven by turbulent transport and are 'inactive' in the sense that they contain very little Reynolds shear stress (or turbulence production). As such, turbulent transport spectra near the wall are also found to share the same *Re*-scaling behaviour with wall dissipation, and this is observed in the spectra of both the wall-normal and inter-scale turbulent transports. The turbulent transport underpinning the increase of wall dissipation with *Re* is characterised by energy fluxes towards the wall, together with inverse energy transfer from small to large length scales along the wall-parallel direction.

Spanwise forcing for drag reduction, and how to understand it via phase-scale-space statistics

M. Quadrio
Politecnico di Milano
Milan, Italy

The talk will provide an overview of the spanwise-forcing approach to turbulent drag reduction, discussing a number of underlying fundamental questions: How does spanwise forcing work? What happens when the Reynolds number is large? In doing so, we'll also take advantage of statistical tools (the phase-aware anisotropic generalized Kolmogorov equations) that effectively describe the flow in the physical and scale space while retaining the phase information that is essential is such a periodically forced turbulent flow.

Split energy cascades in multi-scale injection inhomogeneous anisotropic turbulence

A. Cimarelli
University of Modena and Reggio Emilia
Modela, Italy

According to Kolmogorov’s four-fifths law, the prominent feature of high Reynolds number flows is the energy transfer from large to small scales which is described by a single scalar quantity, the average dissipation rate. Kolmogorov’s groundbreaking intuition was reducing the complex problem of turbulence to its essential features, by assuming homogeneity and isotropy. However, actual turbulent flows have a much richer physics, involving, beyond energy transfer and dissipation, anisotropic turbulent production and inhomogeneous spatial fluxes. The multi-scale feature of these energy injection/release phenomena gives rise to a split cascade where energy flows simultaneously both to small and large scales. The split in forward and reverse cascade is particularly relevant in wall turbulence where it challenges turbulence closures and theories. The aim of the talk is to address the split energy cascade phenomenon by reporting recent advancements based on the generalized Kolmogorov equation [2] computed in the settings of a temporal boundary layer [1]. New results on the phenomenology of the split cascade will be also reported that are based on the evolution equation for the second-order moment of the two-point vorticity increment.

[1] Cimarelli A., Boga G., Pavan A., Costa P. and Stalio E., Spatially

evolving cascades in wall turbulence with and without interface, JFM

987, 2013

[2] Hill R.J., Exact second-order structure-function relationships,JFM 468, 2002

Turbulent diffusion on turbulence cascade

J.C. Vassilicos
CNRS, LMFL
Lille, France

Interscale turbulence transfers and the turbulence cascade are pivotal in turbulent flows. Interspace turbulence transfers (two-point turbulent diffusion) are also present over a range of length-scales. In homogeneous turbulence, where they average to zero at all length-scales, the fluctuations of their solenoidal parts are anti-correlated with those of the interscale turbulence (Larssen & Vassilicos, JFM 969, A14. 2023). Are there such relations between average interscale and interspace turbulence transfers in non-homogeneous turbulence? How do these transfers depend on two-point separation and compare with turbulence dissipation rate? Is there a tendency towards local homogeneity at small enough length scales as commonly believed? To answer these questions, we analyse PIV data from three qualitatively different turbulent wakes (Chen & Vassilicos, JFM 938, A7, 2022) and centreline data from DNS of fully developed turbulent channel flow (TCF) (Apostolidis et al., JFM 967, A122, 2023). In terms of two-point interspace transfer rate, all considered regions in all three turbulent wakes and both TCF centrelines are significantly non-homogeneous even at scales below the Taylor length. This persistent non-homogeneity across the entire inertial range must result from the turbulence cascade interacting with two-point turbulent diffusion (Alexakis, JFM 977, R1, 2023; Beaumard et al., JFM 984, A35, 2024). Recent theory established for situations where two-point turbulence physics are homogeneous even though the turbulence is non-homogeneous (Chen & Vassilicos 2022, Beaumard et al 2024) predicts that average interscale and interspace transfer rates are a fixed fraction of turbulence dissipation rate across the inertial range, quantitatively predicting equal non-homogeneity at all inertial scales. We find close to constant interscale and interspace transfer rates down to the Taylor length on the centreline of our two TCFs and in the further wake regions examined, though sometimes with what may be a higher order correction.

Work done with Ernesto Fuentes Noriega and Jiamei Li

Connections between coherent structures and turbulence: examples from geophysical flows

S. Sarkar
Mechanical and Aerospace Engineering, UC San Diego and Scripps Institution of Oceanography
La Jolla, California, USA

The ocean and the atmosphere are replete with flow structures: coherent vortices or eddies that span the large mesoscale to the smaller submesoscale, internal gravity waves and various flow instabilities that are supported by a stratified, rotating fluid. These flow structures are often treated as distinct from environmental turbulence in the GFD literature with the latter often treated as an enhanced background diffusivity. This *ansatz*, while appealing for application in regional or global climate models, is an oversimplification as we will demonstrate with examples drawn from high-resolution simulations. These examples include a mountain/seamount wake and a submesoscale current at a density front. The spatial localization of turbulence, its consequent inhomogeneity, its length/velocity anisotropy and the two-way connections between flow structures and turbulence in these examples are complexities that are likely more prevalent than not in the environment.

Non-equilibrium turbulence in the Atmospheric Boundary Layer

M. Waclawczyk
Institute of Geophysics, University of Warsaw
Warsaw, Poland

This talk concerns turbulent flows in the Atmospheric Boundary Layer (ABL), which undergo strong temporal and spatial variations due to rapidly changing forcing conditions. Special focus will be given to turbulence shortly before sunset, when the convective ABL collapses rapidly, and to turbulence in stably stratified ABL, which can locally re-laminarise when the stratification increases.

Experimental evidence shows that the evolution of turbulence statistics during the decay of the convective layer is described by the non-equilibrium laws. In particular, the slopes of structure functions and frequency spectra deviate from the Kolmogorov predictions in their large-scale part, the integral length scales first decrease and next tend to increase with time, the rate of change of the standard deviation of vertical velocity deviates from the equilibrium predictions. The results of the analysis suggest that the non-equilibrium scaling relations could be used to improve parametrizations schemes for turbulence during the decay of convective ABL.

The second part of the talk will concern predictions of the turbulence kinetic energy dissipation rate in the surface layer of the stable ABL. Based on the analysis of a large set of observational data of Arctic weather from open databases we show that the non-dimensional dissipation coefficient in the surface layer is a function of local Reynolds number, as predicted by the non-equilibrium scaling relations. In contrast to previous laboratory experiments of near-wall turbulence we could not identify a region where the dissipation coefficient becomes constant. This fact indicates that during the observations the fully developed, statistically stationary state was never reached.

Small scale temperature fluctuations in free atmosphere

S. Malinowski
Institute of Geophysics, University of Warsaw
Warsaw, Poland

The Family of Ultra Fast Thermometers (UFT's), aimed at high-resolution airborne measurements of temperature fluctuations, is in constant development at the University of Warsaw for over of 30 years.

In recent years we were able to collect several series of temperature measurements with the physical resolution of the order of 1cm, which corresponds to the typical Kolmogorov scale of the atmospheric turbulence.

At the workshop we will present and discuss properties of temperature spectra across the range of scales in convective atmospheric boundary layers, cloud interiors and turbulent cloud shells.

We will also present and discuss estimates of the temperature dissipation rates and their PDF's in various regions of free atmosphere.

Work done with Robert Grosz, Jakub Nowak, Stanisław Król, Wojciech Kumala

Coherent structures governing transport at turbulent interfaces

A. Khojasteh
Mechanical Engineering, TU Delft
Delft, Holland

In an experiment on a turbulent jet, we detect interfacial turbulent layers in a frame that moves, on average, along with the turbulent-nonturbulent interface. This significantly prolongs the observation time of scalar and velocity structures and enables the measurement of two types of Lagrangian coherent structures. One structure, the finite-time Lyapunov field (FTLE), quantifies advective transport barriers of fluid parcels while the other structure highlights barriers of diffusive momentum transport. These two complementary structures depend on large-scale and small-scale motion and are therefore associated with the growth of the turbulent region through engulfment or nibbling, respectively. We detect the turbulent-nonturbulent interface from cluster analysis, where we divide the measured scalar field into four clusters. Not only the turbulent-nonturbulent interface can be found this way, but also the next, internal, turbulent-turbulent interface. Conditional averages show that these interfaces are correlated with barriers of advective and diffusive transport when the Lagrangian integration time is smaller than the integral time scale. Diffusive structures decorrelate faster since they have a smaller timescale. Conditional averages of these structures at internal turbulent-turbulent interfaces show the same pattern with a more pronounced jump at the interface indicative of a shear layer. This is quite an unexpected outcome, as the internal interface is now defined not by the presence or absence of vorticity, but by conditional vorticity corresponding to two uniform concentration zones. The long-time diffusive momentum flux along Lagrangian paths represents the growth of the turbulent flow into the irrotational domain, a direct demonstration of nibbling. The diffusive flux parallel to the turbulent-nonturbulent interface appears to be concentrated in a diffusive superlayer whose width is comparable with the Taylor microscale, which is relatively invariant in time.

Work done with Jerry Westerweel.

Active Plasma Control for Sustained Large-Scale Structures in Nearly Isotropic Grid-Generated Turbulence

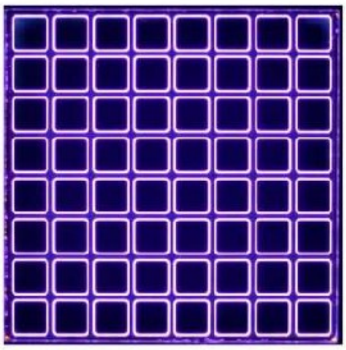
N. Benard, T. Fridlender, J.P. Bonnet and E. Moreau

Institut PPRIME - UPR 3346 – CNRS - Université de Poitiers - ISAE/ENSMA, SP2MI Téléport 2 Bd Marie & Pierre Curie BP 30179, 86962 Futuroscope Chasseneuil Cedex, France

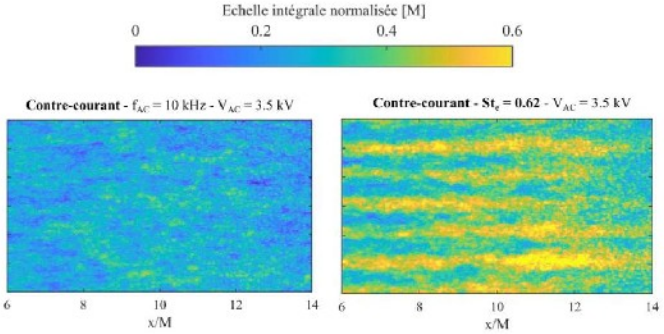
This study explores the active manipulation of turbulence generated by a regular square-mesh grid using Dielectric Barrier Discharge (DBD) plasma actuators. The actuators are strategically positioned along the grid bars to introduce spatially uniform and temporally periodic perturbations, aiming to control the wake dynamics of each bar. The primary goal is to enhance large-scale coherent structures and prolong their persistence downstream, while maintaining conditions approaching homogeneous and isotropic turbulence in the far field.

Experimental investigations, including high-speed planar Particle Image Velocimetry (PIV) at 44 kHz, reveal that plasma actuation effectively influences the initial conditions in the grid's near wake. The actuation modifies the coherent structures arising from the wakes of the square rods, leading to an increase in mixing efficiency and a redistribution of turbulent kinetic energy towards larger scales. Spectral analysis indicates a shift in energy distribution, with enhanced energy content in large-scale motions and a delayed decay of these structures as they propagate downstream. Importantly, the isotropy of small-scale turbulence remains largely unaffected by the actuation.

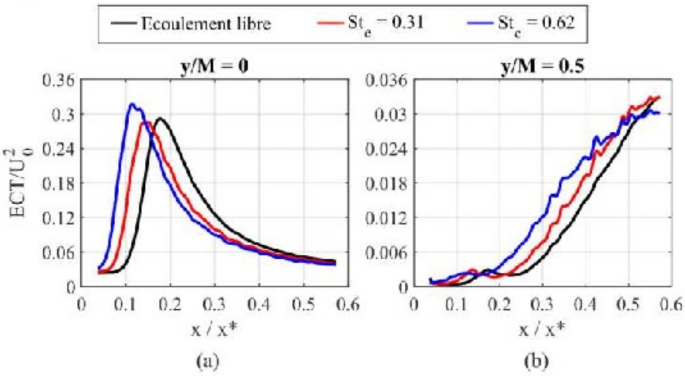
These findings underscore the potential of DBD plasma actuators as effective tools for controlling turbulence characteristics in grid-generated flows. By actively modulating the wake interactions at the grid, it is possible to tailor the turbulence structure, offering new avenues for research in fundamental turbulence studies and practical applications where controlled turbulent mixing is desirable.



Plasma discharge on the rods of the homogeneous grid



Integral length scale for different forcing conditions



Evolution of the turbulent kinetic energy (TKE) in the wake of the central bar (a) and between two bars (b) for the unforced flow and under the influence of the modulations.

Turbulent cascades and stochastic models of droplets breakup

M. Gorokhovski
LMFA, Ecole Centrale de Lyon
Lyon, France

When a droplet in fully developed turbulence is larger than the Kolmogorov length-scale, this droplet is subjected to the turbulent momentum, transmitted by random advection past droplet of dissipative structures by eddies of order of the droplet diameter. Consequently, in stretching and breakup of droplets, the dynamics of velocity gradients at the gas-liquid interface is a key parameter. However, in the numerical simulation of the high Reynolds number flow, thosegradients are usually under-resolved. This motivates the construction of the turbulence-driven atomization models, in which the emphasis is put on the stochastic representation of the intermittent flow structure, “seen” at the gas-liquid interface. In this talk, such models will be described and assessed in different cases. The examples include the primary and secondary atomization in high-speed sprays, the formation of rain droplets, breakup of exhaled droplets. The appearance of universality in the droplet size distribution, the impact of turbulent characteristics, the typical time-and-length scales in the turbulent breakup process – these are essential pointsto be discussed in the talk.

Information about the workshop

The 3 days workshop will take place at the LMFL

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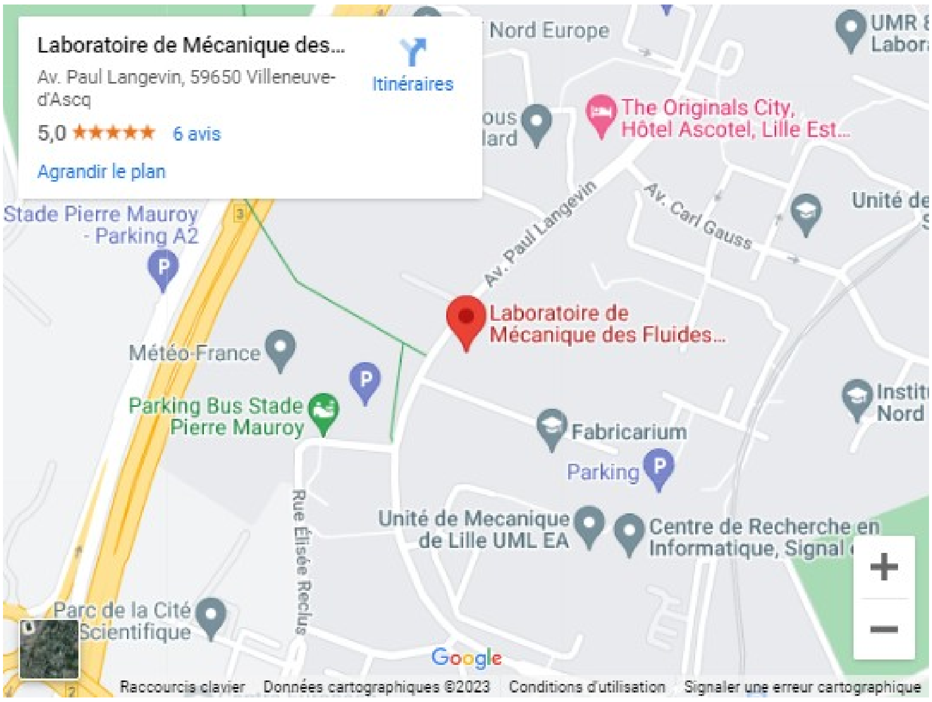

Lille is easily accessible by fast train from Paris (1h), Brussels (30mn) and London (1h30) or directly through Lille-Lesquin airport from several European cities

Metro :

Workshop Dinner on Wednesday 18 June- 20 :00

L’Orange bleue

30 rue Lepelletier, 59000 Lille
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Acces : Riourh subway station (M1)