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# Relaminarising turbulent pipe flow: nonlinear dynamics and optimisation

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Thursday, June 18th (2026), 16:30 Paris Time
LMFL Fluid Mechanics Webinar Link

Dr Elena Marensi is a senior lecturer of Fluid Mechanics in the School of Mechanical, Aerospace and Civil Engineering at the University of Sheffield. Prior to her lectureship in Sheffield, Dr Marensi was an ISTplus Fellow in the Nonlinear Dynamics  Turbulence group at the Institute of Science and Technology Austria and a PDRA in the School of Mathematics and Statistics at the University of Sheffield. Dr Marensi holds a Ph.D. in Mechanical Engineering from the University of Sheffield, jointly with the A*Star Institute of High Performance Computing in Singapore. She obtained her Bachelor and Master degrees in Marine Engineering  Naval Architecture from the University of Genoa, Italy. Dr Marensi's research focuses on transition to turbulence in wall-bounded shear flows, flow instabilities, turbulence modelling and control, and flow optimisation. To tackle these problems she combines mathematical tools with high-fidelity computer simulations and data-driven approaches.

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**Abstract**

Since Reynolds' experiments, pipe flow has remained a canonical setting for understanding how shear-flow turbulence arises and is sustained, with direct implications for flow control. While most control strategies aim to reduce drag within the turbulent regime, recent experiments have shown a more radical possibility: turbulence can be eliminated altogether, with the flow returning to the much more energy-efficient laminar state. Counter-intuitively, and by mechanisms that are not yet fully explained, complete relaminarisation was achieved by momentarily making the flow even more turbulent or by transiently amplifying wall shear. In this talk, I will discuss how this transition from turbulence can be understood and optimised using tools originally developed to study the transition to turbulence. Motivated by the experiments, I will first revisit the dynamical-systems picture of pipe flow in state space, from edge states and minimal seeds to the novel concept of the "upper edge" of chaos, which separates turbulent trajectories from high-energy states that relaminarise. I will then formulate relaminarisation as a family of optimisation problems: designing passive or active body forces, modifying the base-flow velocity profile, and finding the smallest perturbations to turbulent states that trigger decay — the reverse analogue of the minimal seed. By analysing the optimal structures and pathways that mediate relaminarisation, I will discuss what insights can be gained into the self-sustaining mechanisms underpinning shear turbulence, and how these processes might be manipulated most efficiently.


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