UNIVERSITÀ DEGLI STUDI DI GENOVA
SCUOLA POLITECNICA

DIPARTIMENTO DI INGEGNERIA CIVILE, CHIMICA E AMBIENTALE
Scuola di dottorato in Ingegneria Civile, Chimica e Ambientale,

AVVISA DI SEMINARIO

"Global energy fluxes in fully-developed turbulent channels with flow control"

Prof. Maurizio Quadrio
Dipartimento di Scienze e Tecnologie Aerospaziali
Politecnico di Milano.

Giovedi 15 febbraio, 2018 – ore 14.30
Scuola Politecnica
Aula A6 (presso il DICCA)

Il seminario sarà tenuto in italiano o inglese, a seconda del pubblico presente.
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"Global energy fluxes in fully-developed turbulent channels with flow control"

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Abstract

The talk will address the integral energy fluxes in natural turbulent channel flows and in controlled ones, where active skin-friction drag reduction techniques allow a more efficient use of the available power. We study whether the increased efficiency relates to general trends in how energy is dissipated by the mean velocity field (mean dissipation) and by the fluctuating velocity field (turbulent dissipation). Direct Numerical Simulations (DNS) of different control strategies are performed at Constant Power Input (CPI), so that at statistical equilibrium each flow (either uncontrolled or controlled by different means) has the same power input, hence the same global energy flux and, by definition, the same total energy dissipation rate. The simulations reveal that changes in mean and turbulent energy dissipation rates can be of either sign in a successfully controlled flow. A quantitative description of these changes is made possible by a new decomposition of the total dissipation, stemming from an extended Reynolds decomposition, where the mean velocity is split into a laminar component and a deviation from it. Thanks to the analytical expressions of the laminar quantities, exact relationships are derived that link the achieved flow rate increase and all energy fluxes in the flow system with two wall-normal integrals of the Reynolds shear stress and the Reynolds number. The physical meaning of the energy fluxes stemming from the new decomposition unveils their interrelations and their connection to flow control, so that a clear target for flow control can be identified.

Bio

Maurizio Quadrio, PhD, is Professor of Fluid Dynamics at Politecnico di Milano, Department of Aerospace Science and Technology, where he directs the Laboratory of Instability and Flow Control, and is Mercator Fellow at the Karlsruhe Institute of Technology. He serves in the Dept steering committee, and chairs the Scientific Committee. In 2017 he has organized a successful European Drag Reduction and Flow control meeting in Rome, and he is in the organizing committee of the 2020 ICTAM in Milano. He has authored more than 160 publications, including 48 journal publications.

In his research activity Maurizio Quadrio leverages numerical and experimental techniques to investigate turbulent wall flows, and to develop novel methods for reducing the turbulent skin-friction drag. A few years ago, he discovered a promising strategy for drag reduction, and obtained experimental confirmation and theoretical explanation for it. Later research is addressing important practical issues related to its deployment in real-world applications as Reynolds-number effects, energy efficiency and effects of complex geometries. Other research interests include turbulence modelling, fluid dynamics in biological systems, and development of shape optimization tools in CFD.