On the idealization of turbulence: the concept of scale and its modelling

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The most important results in turbulence theory concern the idealization of the flow as composed by different ingredients. Turbulence theories are then genuine results of their first fundamental step: the conceptual decomposition of turbulence. Famous examples are the Reynolds decomposition of the flow in a mean and fluctuating part and the spectral decomposition in a hierarchy of scales of motion. The general aim is to provide a description of turbulence simpler than that given by the full Navier-Stokes equations. However, the nonlinearity of the problem challenges for a reduced description of turbulence giving rise to the well-known closure problem in statistical theories of turbulence. It consists in a coupling of the different levels and scales composing turbulence which interact themselves exchanging momentum and kinetic energy. In the present seminar, a review of the turbulence decompositions and of the related results is presented. Particular attention is devoted to the generalized central moments introduced by the filtering decomposition and to their analogy with the two-point velocity increment. Different flow cases will be considered to present the issue.

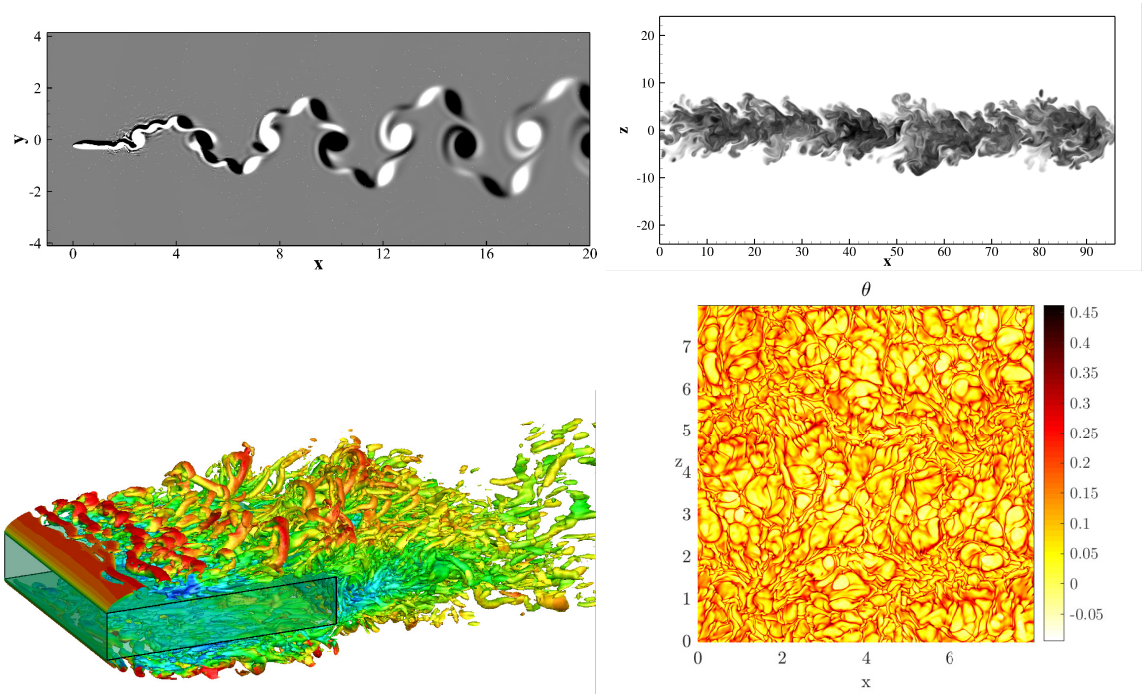

Figure 1: Four examples of turbulent flows. Oscillating airfoil wake, turbulent jet, flow around a rectangular cylinder and Rayleigh-Bénard convection.

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