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Single-phase and particle-laden turbulent flows

I-II) Turbulence in fluids as a stochastic phenomenon:

- short introduction to the phenomenology and physics of turbulent flows;
- statistical approach, Eulerian and Lagrangian correlations, general closure issue;
- ensemble (RANS) vs. spatial (LES) averaging, classes of turbulence models;
- Lagrangian probability density function (PDF) method and its practical implementation in terms of stochastic diffusion processes (Langevin-type,continuous/discrete random walks) for single-phase flows;
- filtered density function method (FDF) in the LES context;
- Lagrangian particle methods: some basics on numerics and time integration of stochastic differential equations;

III-IV) "Multiphysics" turbulence: passive admixtures, disperse two-phase flows:

- scalar variables in turbulence: macro- and micromixing;
- models of turbulent mixing, including stochastic ones;
- some basics on particulate flows and their modelling;
- turbulent diffusion of fluid elements vs. turbulent dispersion of heavy/inertial particles in the context of RANS;
- the subfilter (sub-grid scale) flow impact on particles/droplets in LES;
- related modelling proposals: functional and structural;
- stochastic models of specific phenomena involving particles/droplets: wall deposition, collisions/coalescence, break-up/atomisation.