

COMPUTATIONAL FLUID DYNAMICS – 9 CFU LM

Battistoni (72 ore)

Fluid properties: compressibility, viscosity, surface tension. Fluid kinematics: Lagrangian and Eulerian description, material derivative, strain and rotation tensors. Fluid dynamics: stress tensor and constitutive models.

Basic Principles: conservation equations for mass, momentum, energy, species, in conservative and non-conservative forms, equations of state, transport properties, viscosity, mass diffusivity, thermal diffusivity.

Introduction to computational fluid-dynamics (CFD). Numerical methods: finite volume method. Spatial and temporal terms discretization methods.

Convergence, accuracy, and stability. Equation coupling, pressure-based and density-based solution algorithms. Segregated and coupled solvers. Iterative solution methods for non-linear coupled problems.

Turbulence models. Physics fundamentals: energy cascade and turbulence length-scales. Modeling approaches: Direct Numerical Simulation (DNS), Large Eddy Simulations) LES, Reynolds Averaged Navier-Stokes (RANS). Reynolds equations. Boussinesq hypothesis and two-equation models. Other closure models. Turbulent boundary layer models: standard wall functions, enhanced wall functions, two-layer models, Low-Reynolds models.

Turbulent mixing and reactive flows. Modeling of turbulent mixing and chemically reacting flows. Premixed vs. non-premixed combustion. Turbulence-chemistry interaction. Combustion models for non-premixed/diffusion flames.

Multiphase flows. Lagrangian and Eulerian description. Volume of Fluid method. Two-fluid and single-fluid models. Lagrangian particle method. Interaction among phases.

CFD applications to general turbulent flows, internal combustion engines, turbomachinery, external flows, aerodynamics. Design problems and analyses.

Introduction to High Performance Computing (HPC).