FACOLTÀ DI SCIENZE MATEMATICHE, FISICHE E NATURALI
DIPARTIMENTO DI MATEMATICA E FISICA "NICCOLÒ TARTAGLIA"
INTERNATIONAL DOCTORAL PROGRAM IN SCIENCE

Perspectives in Continuum Mechanics

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Abstract
The course provides a rigorous introduction to fluid mechanics, structured in two main parts.

The first part focuses on the derivation of the fundamental equations of fluid dynamics from the conservation laws of mass, momentum, and energy. The course begins with the simplest assumptions leading to the formulation of the Euler equation for perfect fluids. Key results for perfect fluids, including the Bernoulli and Kelvin theorems, are presented in this context. The framework is then extended to include viscous effects, leading to the derivation of the Navier-Stokes equations for both compressible and incompressible fluids. For this equation, the weak formulation and appropriate boundary conditions are discussed. Classical solutions for confined flows, such as Couette and Poiseuille, are then examined. A brief introduction to the behavior of non-Newtonian fluids is also given.

The second part focuses on the modeling of turbulence phenomena. After introducing the notion of the Richardson cascade, the Reynolds-averaged Navier-Stokes (RANS) equations are examined, along with turbulence closure models, including the Prandtl mixing length theory and the κ-ε and κ-ω models. The modeling of laminar and turbulent boundary layer dynamics is also discussed. Finally, the course concludes with an overview of fluid flow in porous media, including a brief introduction to the Darcy and Brinkman equations.

PhD Course

15 October 2024 (10:30 am - 12:30 pm; 2:30 pm - 4:30 pm)
22 October 2024 (1:30 pm - 5:30 pm)
29 October 2024 (10:30 am - 12:30 pm; 2:30 pm - 4:30 pm)
Sala Riunioni S4
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