Incompressible fluid mechanics

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Summary

Basic lecture in incompressible fluid mechanics

Content

Characteristic quantities of an incompressible flow, hydrostatic, viscous stress, dimensional analysis, Navier-Stoke equations, conservation of mass and momentum in integral and differential form, trajectories and streamlines, Bernoulli's equation, lift and drag of a solid body, theory of reduced scale models, inviscid flows, potential flows, unsteady flows, added mass, vorticity dynamics, introduction to boundary layer concept and of turbulence.

Keywords

Incompressible flows, Navier-Stokes equation, lift, drag

Learning Prerequisites

Recommended courses

• Mechanics of continuous media
• Fluid flow

Learning Outcomes

By the end of the course, the student must be able to:

• Explain and apply the concepts of mass, energy, and momentum balance, E1
• Define, describe and apply the basic flow equations, such as the Navier-Stokes equations, AH14
• Describe simplified governing equations, such as the Bernoulli or potential equations, their domain of validity and apply them in appropriate situations, AH15
• Describe flow in simple geometries, such as over a flat plate, in a tube, or around a sphere or airfoil, AH9
• Link flow behaviour with non-dimensional parameters (e.g. Reynolds and Mach numbers), AH2
• Identify similarity laws and their use for dimensioning an experimental testbed, AH23
• Work out / Determine analytically or numerically the potential flow around an airfoil, AH19
• Describe the physical differences between laminar and turbulent flows, AH4

Transversal skills
• Use a work methodology appropriate to the task.
• Assess one’s own level of skill acquisition, and plan their on-going learning goals.

Teaching methods
Lectures and sessions of exercises

Assessment methods
Written exam

Resources
Bibliography

Ressources en bibliothèque
• Fluid Mechanics / Munson