TAM 531 Fall 2024

Syllabus

Introduction

- What this course is about
- Truly inviscid flow
- Importance of inviscid flow to understanding real flows

Mathematical Preliminaries

- Index notation
- Vectors and tensors
- Differential and integral identities

Kinematics

- Measures of deformation
- Vorticity
- Pathlines, streaklines, and streamlines
- Integral transport theorems

Conservation Laws

- Conservation of mass
- Conservation of momentum and angular momentum
- Navier-Stokes equations

Boundary Conditions

- Fluid/solid interfaces
- Fluid/fluid interfaces

Representations other than Navier-Stokes

- Irrotational flows
- Divergence-free (solenoidal, "incompressible") flows
- Irrotational, divergence-free flows
- Helmholtz Theorem
- Biot-Savart Equation

Vorticity Transport

- Vorticity transport equation and the fundamental difference between two- and three-dimensional flow
- Circulation
- Measures and invariants of vorticity

Two-dimensional Potential Flow

- Linear superposition
- Method of images
- Relationship to complex-variable theory and use of conformal mapping
- Airfoil theory

Three-dimensional Potential Flow

- Flows about axisymmetric bodies
- Slender-body theory

Inviscid Interfacial Waves

- Capillary and gravity waves
- Group velocity