Computational Fluid Dynamics Theory and Applications Volume I

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Introduction

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- Dimensionless numbers
- Equation of state
- Constitutive relations
- Governing equations in conservation law form
- Model equations

- Structured computational meshes
 - Generalized transformations
 - Algebraic methods
 - Differential equations based methods
 - Elliptic methods
 - Hyperbolic methods
- Unstructured grid generation methods
 - Brief introduction

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- Iterative schemes applied to the solution of Laplace equation
- Finite difference methods
 - Model equations solution methods
 - Convergence, consistency, and stability
 - von Neumann analysis
 - Modified equation analysis
- Finite volume formulation

- Solution methods for the inviscid Burgers equation
 - Lax and Lax-Wendroff schemes
 - Beam and Warming scheme
 - Godunov and Roe schemes (approximate Riemann solvers)
 - High order (MUSCL) schemes
 - TVD schemes
 - Limiters

- System of conservation law equations
 - Jacobians

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- Linearization
- Hyperbolicity conditions
- Characteristics
- Boundary conditions
 - Euler equations
 - Navier-Stokes equations

- Transformation of the model equations
- Solution methods for the flow equations
 - Explicit/implicit time marching methods
 - Flux vector splitting
 - Flux difference splitting
 - Viscous flows
 - Discretization methods
 - Implicit schemes
 - Time accurate methods

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- Turbulence models
 - Turbulent flow simulation classes
 - Reynolds-averaged Navier-Stokes (RANS) equations
 - Algebraic models

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- One equation models
- Two equation models
- Reynolds stress models (RSM)
- Numerical difficulties and solution methods

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- Unstructured grid methods
 - Finite volume formulation
 - Inviscid flux
 - High order, gradient computation
 - Viscous flux
 - Boundary conditions
 - Time integration methods
- Case studies