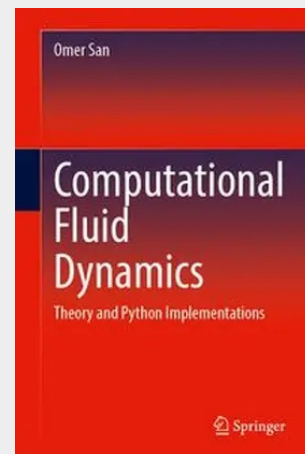


Computational Fluid Dynamics

Theory and Python Implementations

This textbook provides unified treatment of computational fluid dynamics, systematically developing theory, algorithms, and applications from first principles with complete Python implementations. It addresses the critical pedagogical gap in CFD education: the absence of a modern textbook that integrates mathematical rigor with accessible, reproducible computational implementations in Python, the dominant language for scientific computing education. The book covers essential numerical methods (finite difference, finite volume, finite elements, spectral) for both compressible and incompressible flows, treating canonical problems (diffusion, advection, Burgers equation) as pedagogical foundations building toward realistic applications. Modern topics including machine learning for CFD and adaptive mesh refinement are positioned as natural extensions of classical methods. Comprehensive benchmark problems (lid-driven cavity, flow past cylinder, shock tubes, Taylor-Green vortex) provide validated reference solutions and project templates.

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