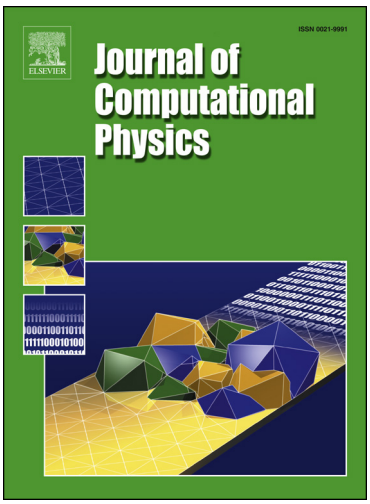
# Accepted Manuscript




Acceleration methods for multi-physics compressible flow

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## Highlights

- The Runge–Kutta (RK)/Implicit smoother scheme is expanded as a convergence accelerator, together with multigrid and low-Mach preconditioning methods to solve wide range of stiff, multi-physics flow problems, some of them are very stiff.
- The method used to solve reactive and turbulent flows, two phase flows, from very low Mach number to supersonic, steady and unsteady.
- A Roe-based upwind scheme with intrinsic modifications to low Mach number flows developed. This scheme solves fast and accurately low very low Mach number problems.
- We discuss what the chemical kinetics theory and the Le-Chatelier's principle can tell us about the mathematical properties of the chemical source terms Jacobian matrix.