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Study of time-accurate integration of the variable-density Navier-Stokes equations[1] XIAOYI LU, CARLOS PANTANO, Mechanical Science and Engineering Department, University of Illinois at Urbana Champaign — We present several theoretical elements that affect time-consistent integration of the low-Mach number approximation of variable-density Navier-Stokes equations. The goal is for velocity, pressure, density, and scalars to achieve uniform order of accuracy, consistent with the time integrator being used. We show examples of second-order (using Crank-Nicolson and Adams-Bashforth) and third-order (using additive semi-implicit Runge-Kutta) uniform convergence with the proposed conceptual framework. Furthermore, the consistent approach can be extended to other time integrators. In addition, the method is formulated using approximate/incomplete factorization methods for easy incorporation in existing solvers. One of the observed benefits of the proposed approach is improved stability, even for large density difference, in comparison with other existing formulations. A linearized stability analysis is also carried out for some test problems to better understand the behavior of the approach.

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