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Finite-element solution for compressible Navier-Stokes flow with density-dependent viscosity and Navier-slip at the wall

Motivated by comparison with a perturbation solution for weakly compressible force-driven flow through a cylinder of fixed cross-section, with density-dependent viscosity and Navier-slip at the wall, a strategy for the numerical solution of the problem using the Finite Element Method is proposed. The element used in the simulations has five degrees of freedom; pressure, velocity in x, y and z directions and temperature. A parabolic velocity profile is imposed at the inlet in such a way that the relationship between centerline velocity and the wall velocity ensures the satisfaction of the Navier-Slip condition at the inlet. The results are compared with the perturbation solution for both approximate and full Navier-slip conditions.