

**Title:** Entropy stable approximations of Navier-Stokes equations with no artificial numerical viscosity

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**Abstract:** We construct a new family of entropy stable difference schemes which retain the precise entropy decay of the Navier-Stokes equations,  $d/dt \int_x (-\rho S) dx = - \int_x ((\lambda + 2\mu)q_x^2/\theta + \kappa(\theta_x/\theta)^2) dx$ . To this end we employ the entropy conservative differences to discretize Euler convective fluxes, and centered differences to discretize the dissipative fluxes of viscosity and heat conduction. The resulting difference schemes contain no artificial numerical viscosity in the sense that their entropy dissipation is dictated solely by viscous and heat fluxes. Our numerical experiments provide a remarkable evidence for the different roles of viscosity and heat conduction in forming sharp monotone profiles in the immediate neighborhoods of shocks and contacts.