1159-76-71 **Loic Cappanera*** (lmcappan@central.uh.edu). *Momentum based approximation of incompressible flows with variable density and viscosity. Applications to magnetohydrodynamics.*

We present a new approximation method for the incompressible Navier-Stokes equations with variable density and viscosity. This method uses the momentum $\mathbf{m} := \rho\mathbf{u}$, with ρ the density and $\mathbf{u}$ the velocity, as dependent variable for the Navier-Stokes equations which results in a time-independent mass matrix that is suitable for spectral methods. The incompressibility condition of the flow is enforced via an artificial compression method. To improve the efficiency of the method for large scale computations, the stiffness matrix is made time independent by rewriting appropriately the diffusion operator and the grad-div operator that enforces the incompressibility of the flow. A level set method is applied to reconstruct the density and viscosity of the fluid. After establishing the stability of the algorithm, we study its convergence properties numerically with manufactured solutions involving a large range of ratios of density and viscosity. Comparisons with a pressure-correction projection method are also provided. Eventually, we extend the method to conducting fluids with variable electrical conductivity to study magnetohydrodynamics problems such as the metal pad roll instability. (Received July 29, 2020)