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Existence and approximation for non-isothermal fluid flows with Tresca's friction and Cattaneo's heat law

Motivated by lubrication and extrusion phenomena, we consider a two dimensional non-isothermal incompressible fluid flow involving heat transfer and friction. We model heat conduction with Cattaneo's law instead of the commonly used Fourier's law, in order to overcome the physical paradox of infinite propagation speed. We assume a strong coupling due to temperature dependent viscosity and velocity dependent heat capacity. The problem is thus described by a Navier-Stokes system with Tresca's friction law on a part of the boundary, coupled with the hyperbolic heat equation. By using a time-splitting technique, we construct a sequence of decoupled approximate problems and we prove the convergence of the corresponding approximate solutions, leading to an existence theorem for the coupled fluid flow/heat transfer problem. Finally, we present some numerical tests to illustrate our theorical results.