

# Abstract

This dissertation is devoted to the finite element (FE) approximation of equations describing the motion of a class of non-Newtonian fluids. The main focus is on incompressible fluids whose viscosity nonlinearly depends on the shear rate and pressure. The equations of motion are discretized with equal-order  $d$ -linear finite elements, which fail to satisfy the inf-sup stability condition.

In this thesis a stabilization technique for the pressure-gradient is proposed that is based on the well-known local projection stabilization (LPS) method. If the viscosity solely depends on the shear rate, the well-posedness of the stabilized discrete systems is shown and a priori error estimates quantifying the convergence of the method are proven. In the shear thinning case, the derived error estimates provide optimal rates of convergence with respect to the regularity of the solution. As is well-known, the Galerkin FE method may suffer from instabilities resulting not only from lacking inf-sup stability but also from dominating convection. The proposed LPS approach is then extended in order to cope with both instability phenomena. Finally, shear-rate- and pressure-dependent viscosities are considered. The Galerkin discretization of the governing equations is analyzed and the convergence of discrete solutions is quantified by optimal error estimates.