Incompressible, elastic materials and large deformations

Martina Balg[1] Arnd Meyer[2]

A fast and efficient simulation of modern materials, like (nearly) incompressible nonlinear elastic materials, underlying a large deformation has become more and more interesting in recent years. To avoid the occurrence of the infinite bulk modulus in the corresponding deformation problem, it is a common approach to introduce a new variable, the hydrostatic pressure, and to work with a mixed formulation.

In this talk we will present a formulation to numerically simulate the deformation $\boldsymbol{U}$ and the hydrostatic pressure P on a three-dimensional region Ω by using a mixed, adaptive finite element method. Starting from the equilibrium of forces we will derive the weak form of the deformation problem, which is nonlinear and can be solved with a Newton's method and incremental load steps. In every iteration step this will lead to a saddle point problem. By using Taylor Hood finite elements we will obtain a discrete, indefinite problem, which can be handled with the Bramble Pasciak conjugate gradient method. Finally we want to discuss some modifications to improve the simulation and give some numerical results.

[1] Chemnitz UT, Faculty of Mathematics, Chemnitz, Germany,
martina.balg@mathematik.tu-chemnitz.de

[2] Chemnitz UT, Faculty of Mathematics,
arnd.meyer@mathematik.tu-chemnitz.de