On the $\mathcal{Q}_2$-$\mathcal{Q}_0$-element for (nearly) incompressible material under large deformations

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In recent years the fast and efficient simulation of modern materials has become more and more important since it is a useful tool to study the behavior of mechanical components under strain without performing an expensive experiment. One of these modern materials is the (nearly) incompressible non-linear elastic material which is characterized by an (almost) infinite bulk modulus. This means that under any load it may change its shape but it will keep its initial volume.

In this talk we will present an adaptive mixed finite element method to determine both the deformation U and the hydrostatic pressure P of a three-dimensional domain Ω in the context of large deformations for (nearly) incompressible material. Starting from the non-linear weak formulation of the deformation problem the mathematical description leads to a saddle point problem. This mixed formulation allows the usage of a mixed FEM. Based on a hexahedral discretisation of the domain Ω we want to apply the $\mathcal{Q}_2$-$\mathcal{Q}_0$ finite element and compare its performance to the Taylor-Hood element in numerical tests.

References:

[1] M. Balg, A. Meyer: Fast simulation of (nearly) incompressible nonlinear elastic material at large strain via adaptive mixed FEM. Chemnitz: Chemnitz Scientific Computing CSC/12-03, 2012.

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