Symmetric Mixed Formulation for Reinforced Elastomers

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Elastomers are used in many applications like air suspensions and belts, like drive-, timing- or conveyor-belts. Reinforcing them with fibres or twines improve their stiffness in a wanted direction. Furthermore, these fibre-reinforced elastomers can undergo large deformations without failure. Unfortunately, the simulation of this materials is rather hard, due to the low shear modulus of the elastomers in contrast to the high bulk modulus and the high fibre-stiffness. In more detail, in the corresponding Newton-system the low shear modulus is multiplied with the positive definite part and the other two high values are multiplied with some low-rank parts. Of course, mixed finite element methods can be used to tackle the (almost)-incompressible behaviour of elastomers. Additionally, we discuss how a mixed formulation for the (almost)-inextensible behaviour of the fibres can be achieved. Further, we present an easy way to achieve a symmetric mixed formulation Newton-system, from the substitution of variables for our specific energy density.

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