Optimal Control in Elasticity for Large Deformations

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Abstract: Large deformation elasticity differs in various ways from the well-known linear elasticity system. First of all, the undeformed and deformed domains have to be distinguished. Balance equations are only formulated for the unknown deformed domain and they have to be transformed to the undeformed reference domain for the usage, e.g., of finite element methods. This geometry transformation introduces non-linearity into the system. Other sources of non-linearity are the elastic material laws, which are derived from the minimization of phenomenological models of the stored elastic energy. Together, these observations give rise to a highly non-linear forward problem which can be solved by Newton's method and possibly additional incremental steps of increasing load for globalization purposes.

As a first approach for an associated optimal control problem, we consider external loads as the control variable. We seek to come close to a given desired deformation. Optimality conditions and numerical examples will be presented.

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