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TOPOLOGY OPTIMIZATION OF NON-LINEAR STRUCTURES

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Abstract: In this talk we combine topology optimization with constraints on the stability. Large strains are considered and consequently we implement a hyper-elastic constitutive model. To trace the load-path, the Crisfield path following method is used and in each load step we detect critical points. In most topology optimization procedures the detection is performed by solving a linearized problems which renders an eigenvalue problem. Another route is to solve an extended system where the conditions forthe critical point directly is included. Both approaches will be considered in the presentation. In void or nearly void regions, spurious buckling modes can be triggered which compromises the solution. A common approach to overcome this problem is to modify the stiffness matrix such that these buckling modes are eliminated. This modification comes with the risk of loosing convergence rate in the Newton iterations. In this talk we will discuss a consistent scheme that is able to reduce the risk of spurious buckling without compromising the convergence rate of the Newton scheme. To demonstrate the procedure, numerical examples where structures are optimized for maximum end-tangent stiffness and constrained in terms of stability are presented. This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore Laboratory under Contract DE-AC52-07NA27344.