Projection-based model reduction for contact problems

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Abstract

Large scale finite element analysis requires model order reduction for computationally expensive applications such as optimization, parametric studies and control design. Although model reduction for nonlinear problems is an active area of research, a major hurdle is modeling and approximating contact problems. This manuscript introduces a projection-based model reduction approach for static and dynamic contact problems. In this approach, non-negative matrix factorization is utilized to optimally compress and strongly enforce positivity of contact forces in training simulation snapshots. Moreover, a greedy algorithm coupled with an error indicator is developed to efficiently construct parametrically robust low-order models. The proposed approach is successfully demonstrated for the model reduction of several two-dimensional elliptic and hyperbolic obstacle and self contact problems.

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