Auxiliary Space Preconditioner for a Locking-free Finite Element Approximation of the Linear Elasticity Problem

E. Karer, J. Kraus, L. Zikatanov

In this talk we consider a stable finite element discretization of the equations of linear elasticity, introduced by R. Falk (R. Falk, Nonconforming finite element methods for the equations of linear elasticity. Math. Comp., 57(196), 1991, pp. 529–550), with a focus on nearly incompressible materials. This discretization does not suffer from so-called locking effects as they are observed when using standard low(est) order conforming methods for the pure displacement formulation. In case of pure traction boundary conditions optimal order error estimates are available based on an appropriate discrete version of Korn's second inequality. The focus of this work is on constructing uniform preconditioners for the linear systems arising from this discretization scheme. We introduce an auxiliary space method which consists in solving an auxiliary problem that involves a bilinear form on a larger auxiliary space. By defining a proper projection from this larger space to the original space a suitable preconditioner for the original problem can be set up. We discuss the details of the construction, derive spectral equivalence results based on the fictitious space lemma and present numerical experiments.