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On a New Mixed Formulation of Kirchhoff-Love and Reissner-Mindlin Plates and Shells

In 2D linear elasticity it is well-known that a stress tensor field satisfying the homogeneous equilibrium equation can be expressed in terms of the Airy stress function provided the domain is topologically simple. There is a similar result for the bending moment tensor field in plate models, if the mid-surface of the plate is simply connected. While the stress tensor field in 2D linear elasticity can be written as a second-order differential operator applied to the Airy stress function, the bending moment tensor field in plate models is only a first-order differential operator applied to some 2D vector field.

We will show how this result can be used to reformulate the Kirchhoff-Love and the Reissner-Mindlin plate and shell models as well-posed second-order systems.

The reformulation of the plate and shell models as second-order systems allows for discretization methods in approximation spaces with continuous functions. This includes standard continuous Lagrangian finite element methods and spline spaces from isogeometric analysis on multi-patch domains with continuous patching only.