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STRUCTURE-PRESERVING INTEGRATION WITH MIXED FINITE ELEMENTS

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In the present work we consider structure-preserving integration methods in the context of mixed finite elements. Low-order mixed finite elements such as the shell element proposed in [1] typically exhibit improved coarse mesh accuracy. On the other hand energy-momentum (EM) consistent time-stepping schemes have been developed in the realm of nonlinear structural dynamics to enhance the numerical stability properties. EM schemes typically exhibit superior robustness and thus offer the possibility to use large time steps while still producing physically meaningful results. Accordingly, combining mixed finite element discretizations in space with EM consistent discretizations in time shows great promise for the design of numerical methods with superior coarse mesh accuracy in space and time.

Starting with a general Hu-Washizu-type variational formulation we develop a second-order accurate structure-preserving integration scheme. The present approach is applicable to a large number of mixed finite element formulations. As sample application we will deal with the mixed shell element [1]. The resulting method can be viewed as mixed extension of the EM method proposed in [2]. Numerical examples dealing with large deformations will show the improved coarse mesh accuracy in space and time of the advocated approach.

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