E1-19: Enhanced strain finite element method

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The popularity of the enhanced strain finite element method can be ascribed to the fact that it is based on a simple element of low order, which nevertheless provides a means of overcoming the poor performance of standard low-order elements (for example, the bilinear quadrilateral in 2 dimensions) in bending dominated problems. It also provides a means of circumventing the problems associated with locking, in the small compressibility range.

This work is concerned firstly with convergence of the enhanced strain finite element method, for the case in which isoparametric elements are used. Subject to certain conditions on the basis functions employed, convergence is at the optimal rate. This does not answer the question of why the method behaves so well in the coarse mesh regime. An extensive set of numerical tests sheds some light on this issue. The theoretically predicted rates of convergence are reproduced numerically, but it is clear from the numerical results that, in an error estimate of the form $\| \text{error} \| \leq Ch^k$ in which h is the mesh size and k the order of convergence, the constant C is very much smaller for the enhanced case than for the standard case.