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New Unsymmetric Finite Elements Based on Analytical Trial Solutions Insensitive to Severe Mesh-Distortion

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The unsymmetric FEM [1] is a very promising technique to produce high-performance finite elements with good numerical accuracies and high tolerances to mesh distortions [2]. In this work, some new unsymmetric element models, including 4-node 12-DOF and 8-node 16-DOF quadrilateral ones and 3-node 9-DOF trilateral one, are developed for analysis of the plane problems within the framework of the so-called improved unsymmetric formulae [2], which is characterized by directly adopting a reasonable self-equilibrium stress field to be the element's trial functions. This stress field is obtained based on the analytical trial solutions of related problems and the quasi-conforming technique, thus can *a priori* satisfy the governing equations.

Extensive numerical tests reveal that these new unsymmetric elements exhibit excellent capabilities for predicting the results of both displacement and stress, and exceptional robustness in distorted meshes. In particular, the quadrilateral elements can still work very well, even when the element shapes severely deteriorate into concave quadrangle or degenerated triangle.

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