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Triangular and tetrahedral elements for strain-gradient theories

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Finite element modelling using strain-gradient theories requires specific types of elements, as the underlying partial differential equation to be solved is of fourth order. While many different elements have been proposed and used for two-dimensional problems, three dimensional problems have only recently been considered, using hexahedral elements. In this paper we review the triangular elements that have been proposed in the literature for strain-gradient problems, and consider the challenges involved in obtaining similar tetrahedral elements. We focus especially on the search for a tetrahedron with continuous and smooth interpolation that allows the use a displacement-only finite element formulation. Where possible, lower limits for the number of degrees of freedom per element possible in each class of elements are presented to provide an indication of the computational efficiency of the respective finite elements.

Keywords: strain gradient theories, finite elements, triangular, tetrahedral

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