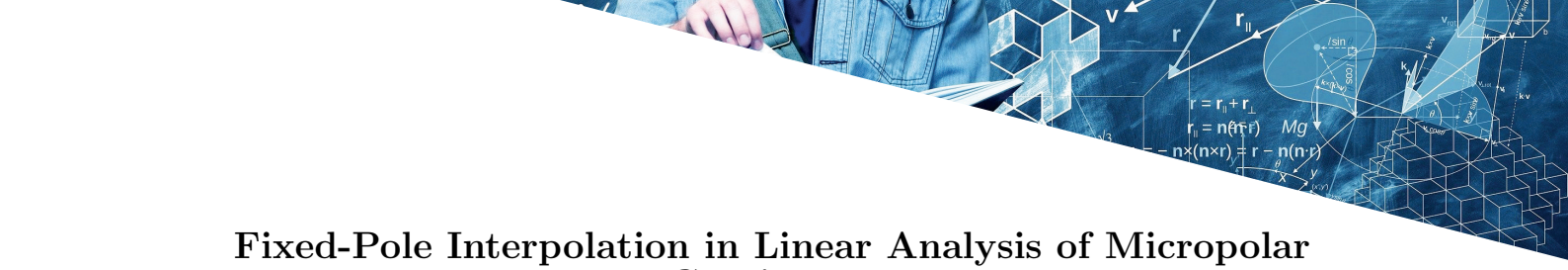

Fixed-Pole Interpolation in Linear Analysis of Micropolar Continuum

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ABSTRACT

A formulation of the micropolar finite element with fixed pole interpolation for a linear static analysis is presented. The newly introduced interpolation is inspired by the fixed-pole concept introduced by Borri and Bottaso in a paper [1], where it was applied to the geometrically nonlinear 3D beams. The concept has proven to be particularly useful in nonlinear dynamics, but so far no attempts have been made to apply it in linear analysis, where the advantages of the concept can be expected.

We have shown that the shear locking can be eliminated with the appropriate application of the concept in the analysis of the Timoshenko beam. Given the fact that the Timoshenko beam actually represents the 1D micropolar (Cosserat) continuum, this developed element provided the basis for the further development of 2D and 3D micropolar finite elements with interpolation based on the fixed-pole concept.

For the approximation of the micropolar 3D continuum, hexahedral elements with 8 nodes and 6 degrees of freedom per node were used, while for the approximation of the micropolar 2D continuum, quadrilateral finite elements with 4 nodes and 3 degrees of freedom per node were used. The elements are tested through numerical examples consisting of a set of patch tests. Numerical solutions obtained using elements with fixed-pole interpolation were compared with those using a conventional Lagrangian interpolation and the linked interpolation (which is similar to fixed-pole interpolation) to identify improvements of the new elements.

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