Isogeometric Analysis of Continua under Point and Line Forces in First and Second Strain Gradient Elasticity

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ABSTRACT

Point forces and force distributions along lines are basic concepts in mechanics. In continuum mechanics, where the Cauchy continuum (i.e., a continuum equipped with an elastic energy that depends on the gradient of the displacement) is used, these concepts are not integrated. Such boundary conditions along lines or on points result in singularities of the displacement field. If one wants to introduce point and line forces (or point and line displacements) to continuum mechanics, one must generalize the concept of the Cauchy continuum [1].
In this contribution, the second- and the third-gradient elasticity theories are implemented in the isogeometric analysis framework. It is shown that the second- and the third-gradient theories are needed to analyze the model under edge and point displacement boundary conditions, respectively. The outcomes also show that taking advantage of the higher continuous NURBS shape functions, with less number of degrees of freedom and a shorter analysis time, the IGA results are more accurate comparing to their Lagrangian finite elements counterparts.

REFERENCES

[1] Reiher JC, Giorgio I, Bertram A (2016) Finite-element analysis of polyhedra under point and line forces in second-strain gradient elasticity. J Eng Mech-ASCE 143 Issue 2.