Non-uniform Rational Lagrange/Hermite Functions and Their Applications to Isogeometric Analysis of In-plane and Out-of-plane Vibration and Deformation of Thin Plates

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ABSTRACT

New basis are developed for isogeometric analysis (IGA) to overcome the difficulties of IGA using NURBS (Non-Uniform Rational B-Splines) on coping with Dirichlet boundary conditions and C^1 continuity between patches. The new basis are constructed through rational local Lagrange or Hermite interpolation and are evaluated in similar procedure as the finite difference method. The new basis neither span the NURBS space nor the classical (rational) Lagrange or Hermite space. Due to their equivalence to NURBS, the new basis are named as non-uniform rational Lagrange/Hermite (NURL or NURH) basis. IGA using NURL or NURH include the finite element method as a special case but the geometry in IGA using NURL or NURH is exact. IGA using NURL or NURH can also carry out *k*-refinement as NURBS. Dirichlet boundary conditions can be directly imposed in IGA using NURL or NURH because they are interpolation basis. A method of directly transforming the tensor product basis of triangular patches to area coordinates is presented and the singularity problem at the edge degenerate to a single point is solved. The methods developed in this work are applied to in-plane and out-of plane vibration and deformation of thin plates. Comparisons with available results in literatures showed the fast convergence and high accuracy of IGA using NURL or NURH and the transformation method for triangular patches. A MATLAB toolbox of NURL and NURH is also introduced.

REFERENCES

[1] T.J.R. Hughes, J.A. Cottrell and Y. Bazilevs, "Isogeometric analysis: CAD, finite elements, NURBS, exact geometry and mesh refinement", *Computer Methods in Applied Mechanics and Engineering*, **194**, 4135-4195 (2005).

[2] B. Liu, Y.F. Xing, Z.K. Wang and X.F. Lu, "Non-uniform rational Lagrange functions and its applications to isogeometric analysis of in-plane vibration and deformation of plates", *Computer Methods in Applied Mechanics and Engineering*, (revision under reviewing).