Isogeometric analysis – moving beyond the finite element method: our recent developments

Hung Nguyen Xuan[1*,2]

[1]*Department of Computational Engineering, Vietnamese-German University, New City, Binh Duong Province, Vietnam*

[2]*Department of Architectural Engineering, Sejong University, 98 Kunja Dong, Kwangjin Ku, Seoul 143-747, South Korea*

The NURBS-based isogeometric analysis (IGA) [1,2] was recently proposed to preserve exact geometries and to enhance very significantly the accuracy of the traditional finite elements. It is promising to make a revolution in computational science. Being different from basis functions of the standard FEM based on Lagrange polynomial, the IGA utilizes non-uniform rational B-spline (NURBS), resulting in both exact geometric representation and high order accuracy. The B-splines (or NURBS) provide a flexible way to make refinement and degree elevation. They enable us to achieve easily the smoothness with arbitrary continuity order compared with the traditional FEM.

This talk aims to introduce shortly a part of our recent developments in isogeometric analysis for a wide range of mechanics problems. The talk will point out several following topics: 1) Isogeometric approach using polynomial splines over hierarchical T-meshes to structural analysis [3,4]; 2) novel unified framework via NURBS-based isogeometric approach into multilayered plate/shell structures relied on both first-order deformation plate theory (FSDT) [5] and higher-order deformation plate theory (HSDT) [6,7]; 3) isogeometric limit analysis of structures [8]; 4) extended NURBS-based isogeometric approach (XIGA) into cracked solids [8,9]; 5) Isogeometric analysis based heterogeneous multiscale method (IGA-HMM) [10]; 6) mixed NURBS-based isogeometric approach for

* Corresponding author. *Email address*: hung.nx@vgu.edu.vn (H. Nguyen-Xuan).

incompressible media [8] and 7) rotation-free isogeometric approach to structural analysis [4,11]. Additional numerical examples are provided to demonstrate the effectiveness and robustness of the methodology.

Keywords: NURBS; Finite elements; Isogeometric analysis; mechanics problems.

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