Civil Engineering at JOHNS HOPKINS UNIVERSITY

CISMMS
Center for Integrated Structure-Materials Modeling and Simulation

CE-CISMMS Graduate Seminar

Large Deformation Analysis of Composite & Functionally Graded Shells: Recent Developments

In this lecture a high-order spectral/hp continuum shell finite element for the numerical simulation of the finite deformation mechanical response of elastic shell structures is discussed. The shell element is based on a modified first-order shell theory using a 7-parameter expansion of the displacement field. The seventh parameter is included to allow for the thickness stretch, and fully three-dimensional constitutive equations are used. The finite element coefficient matrices and force vectors are evaluated numerically using appropriate high-order Gauss-Legendre quadrature rules and the virtual work statement is further integrated numerically through the shell thickness at each quadrature point of the mid-surface; hence no thin-shell approximations are imposed in the numerical implementation. For laminated composite shells, we introduce a user prescribed vector field (defined at the nodes) tangent to the shell mid-surface. This discrete tangent vector allowes for simple construction of the local bases associated with the principal orthotropic material directions of each lamina. As a result, we were free to employ skewed and/or arbitrarily curved elements in actual finite element simulations. Through the numerical simulation of carefully chosen benchmark problems, it is shown that the developed shell element is insensitive to all forms of numerical locking and severe geometric distortions.

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Prof. J.N. Reddy is a Distinguished Professor and holder of the Oscar S. Wyatt Endowed Chair in Mechanical Engineering at Texas A&M University. Dr. Reddy is most well known for his research in the development of higher-order theories of plates and shells. His shear deformation plate and shell theories and their finite element models and penalty finite element models of fluid flows have been implemented into finite element computer programs like ABAQUS, NISA, and HyperXtrude. Dr. Reddy earned numerous awards and honors. He is a member of the National Academy of Engineering and fellow of the Indian National Academy of Engineering.

Thursday, September 24, 2015, 12:00-1:15pm
JHU Homewood Campus, Hackerman Hall B-17

Seminar is <u>FREE and open to the public</u>. Attendance is required for all enrolled Civil Engineering graduate students. For parking please see link for visitors at www.jhu.edu & select information on Homewood Campus. For CISMMS information, visit http://cismms.jhu.edu