THE UNIVERSITY OF ARIZONA
College of Engineering

Aerospace and Mechanical Engineering Seminar

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Peridynamics for Failure Prediction in the Presence of Material Nonlinearity and Finite Deformation

Abstract: Peridynamic (PD) theory is a non-classical continuum theory based nonlocal interactions between the material points in a body. The interaction occurs between two material points over a finite distance referred to the horizon. The PD equation of motion is an intergro-differential equation, and the integrand is free of spatial derivatives of field variables. Therefore, it is applicable in presence of discontinuities in the domain. PD theory is primarily applied to predict crack initiation and propagation in materials. Cracking is achieved through removing the interactions (bond) between the material points.

This study applies PD theory for predicting deformation and failure in rubber like materials, soft polymer's, viscoelastic adhesives in bonded lap joints, creep at high temperature and beam structures under quasi static loading conditions. The force density vectors in PD equilibrium equations are derived both material and geometric nonlinearities. The nonlocal deformation gradient tensor is computed in a bond-associated domain of interaction using the PD differential operator. Dirichlet and Neumann boundary conditions are directly imposed on the boundary layer using the weak form of peridynamics. The fidelity of this approach is established in the absence of failure by comparison with benchmark solutions under simple loading conditions. Subsequently, its validity for predicting damage is demonstrated through simulations of experiments concerning progressive damage growth.

Bio: Deepak Behera is a Ph.D. candidate in the Department of Aerospace and Mechanical Engineering at the University of Arizona under the supervision of Prof. Erdogan Madenci. He received his B.Tech – M.Tech dual degree in Aerospace Engineering from Indian Institute of Technology (IIT) Kanpur, India in 2012. He is the instructor of the course, Mechanics of Materials Laboratory (AME 324L). Before joining Ph.D., he worked for General Electric-Aviation, India for 2.5 years. During his Ph.D., he did his summer internship at Idaho National Laboratory (INL), USA. His research is focused on computational mechanics of materials and structures by using peridynamics and finite element method.

Tuesday, April 27th at 4:00 PM

Zoom Link: Email eperumala@arizona.edu