Title: Finite element modeling of anisotropy – Composite and Metal applications

Abstract:

The presentation includes finite element modelling of anisotropy for two different material systems: fiber-reinforced composites and metallic materials.

Composites: I will present a numerical methodology to find the optimum fiber steering directions, for any given boundary conditions, that reveal continuous and manufacturable fiber angle distributions. Currently, automated fiber placement systems allow manufacturing of fiber reinforced composites by steering of the tow pre-preg material that gives freedom to place the tows along any direction within certain manufacturing limits (ex. fiber steering radius). The optimization method gives promising results for compliance minimization for different boundary conditions and geometries. The designed system for a tensile loaded plate with a discontinuity (hole) are experimentally manufactured using 3D polymer printing and tested.

Metals: I will show the application of crystal plasticity and finite element method to a few crystal case in order to better understand grain boundary mechanics. I have used two different models: classical phenomenological and novel physically based constitutive laws, to further understand effect of physics based strain hardening interactions. The comparison of the results to the experimental findings highlight the importance of additional non-local considerations to capture the grain boundary behavior.