11:10 AM-11:35 AM

***Coupled Heat Conduction and Thermo-viscoelastic Analyses of Polymeric Composites***

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**Abstract**

Polymer matrix composites exhibit significant viscoelastic behaviors when exposed to coupled mechanical and thermal effects. Viscoelastic materials are dissipative materials and deformations in the viscoelastic bodies could generate significant amount of heat, increasing the temperature of the bodies, and elevated temperatures accelerate creep/relaxation in the body, leading to a fully coupled thermo-mechanical response. This study presents a multi-scale material model for analyzing coupled nonlinear heat conduction and thermo-viscoelastic deformation of multi-layered fiber reinforced polymeric composites. The multi-scale material model is implemented in finite element (FE) and used for analyzing time-dependent responses of composite structures under coupled mechanical and thermal stimuli. Short-term (30 minutes) creep tests on off-axis multi-layered specimens are also conducted under combined stresses and temperatures to calibrate in-situ fiber and matrix properties and verify the predictions of the multi-scale framework. A time-shifting method is applied to create long-term material behaviors from the available short-term creep data. Furthermore, the multi-scale model is modified to incorporate the dissipation of energy from the viscoelastic constituents. The dissipation effect is important when the composite structures are subjected to cyclic mechanical loading over a relatively long period of time, which will be useful in determining fatigue life of composite structures.