Center for Soft Matter and Biological Physics

Discussion Meeting

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"*Multi-physics modeling of complex materials and structures* "

Friday, October 9, 2020

4:00pm - 5:00pm

Virtual Zoom Link: https://virginiatech.zoom.us/j/98206647899

Many structures in aerospace, civil and mechanical systems, work in severe environments and exhibit complex responses. An improved understanding of the service performance of complex structures demands multi-field modeling techniques with great efficiency and high-fidelity. Progress in material science also advances manufacturing of high-performance materials, making it essential to characterize the multi-physics properties of complex materials. In this talk, the speaker will introduce computational methods and formulations of theoretical models for coupled multi-physics modeling's of materials and structures that exhibit complex system behaviors, with specific interest on carbon nano-tubes (CNTs)-reinforced composites and thin-walled structures

The presentation will first briefly discuss a locking-free solid-shell element for the large-deformation thermo-mechanical analyses of thin walled structures. Numerical examples demonstrate the proposed element can achieve the accuracy of the high-order element with more than 85% reduction of computational cost. Next, a computational framework will be presented for coupled thermo-mechanical analyses of interface separation and heat transport in carbon nano-tubes (CNTs) enhanced composites, providing an alternative to molecular dynamics in carrying out multi-physics simulation of CNT-composites with less computational cost. The study indicates that composites containing higher volume fraction or better alignment of CNTs may not have more better mechanical behavior in thermo-mechanical loading. Lastly, the speaker will introduce two analytical methods, which are based on the shear-lag model and the multi-scale homogenization concept respectively, to efficiently characterize mechanical properties of composites with interface debonding.