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The AAE Spring 2017 Colloquium Series Presents

"Spatial and Temporal Multiscale Models for Advancing the Integrated Computational Structure-Materials Engineering Initiative"

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Abstract

This talk will present an integration of methods in Computational Mechanics and Computational Materials Science to address the deformation and failure characteristics of polycrystalline metals in various applications. Specifically it will address physics based modeling at different scales and multi-scale spatial (scale-bridging) and temporal modeling methods for Titanium and Nickel based-superalloys. Spatial scales will range from microstructure to component scales. The talk will begin with methods of 3D virtual image construction and development of statistically equivalent representative volume element at multiple scales. Subsequently it will discuss the development of novel system of experimentally validated physics-based crystal plasticity finite element or CPFE models to predict deformation and micro-twinning leading to crack nucleation. These CPFE simulations will provide a platform for the implementation of physics-based crack evolution criterion that accounts for microstructural inhomogeneity. A wavelet transformation based multi-time scaling (WATMUS) algorithm for accelerated crystal plasticity finite element simulations will be discussed as well. The method significantly enhances computational efficiency in comparison with conventional single time scale integration methods. Finally, the development of parametrically homogenized constitutive models (PHCM) from crystal plasticity simulations of deformation leading to fatigue cracking in polycrystalline Ti alloys will be discussed. The PHCM account for the variability in the microstructural morphology. It is important to quantify the microstructural morphology through parameters, which can be explicitly represented in the constitutive response functions. These reduced order models makes them suitable for large-scale structural simulations.

Bio

Professor Somnath Ghosh is the Michael G. Callas Professor in the Department of Civil Engineering and Professor of Mechanical Engineering and Materials Science & Engineering at Johns Hopkins University. He is the founding director of the JHU Center for Integrated Structure-Materials Modeling and Simulation (CISMMS) and the Air Force Center of

Excellence in Integrated Materials Modeling (CEIMM). His research focuses on multi-scale structure-materials analysis and simulations, multi-physics modeling and simulation of multi-functional materials, materials characterization, process modeling, and emerging fields like Integrated Computational Materials Engineering (ICME). He has conducted pioneering research to advance the field of integrated computational structure-materials modeling into new areas of importance and challenges.