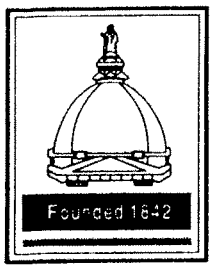
AEROSPACE & MECHANICAL ENGINEERING



2010 COLLOQUIUM 2011

SEMINARS ARE OPEN TO THE PUBLIC

INFORMAL COFFEE PERIOD BEFORE THE SEMINAR IN ROOM 365 FITZPATRICK HALL

UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA 46556

SPEAKER: Dr. Caglar Oskay
Civil and Environmental Engineering Department
Vanderbilt University
Nashville, Tennessee

TOPIC: MULTISCALE COMPUTATONAL MODELING OF FAILURE IN MATERIALS AND STRUCTURES

DATE: Tuesday, November 9, 2010

TIME: 3:30 p.m.

PLACE: 136 DeBartolo Hall

ABSTRACT

Computational modeling of failure in complex, heterogeneous materials is critical to analysis and design of novel mechanical and functional structures subjected to extreme environments and loading conditions. The modeling problem is particularly challenging when the response is influenced by concurrent phenomena occurring at multiple scales, and in the presence of the strong coupling effects between physical processes triggered by extreme environments and loads.

We present a new computational framework for mechanical failure analysis of materials and structures subjected to extreme events. In particular, we will examine two classes of problems. First is the analysis and prediction of composites subjected to failure loads. We formulate a generalized computational homogenization theory that incorporates failure mechanisms within composite constituents and interfaces. The computational cost problem associated with hierarchical multiscale methodologies is alleviated by devising a reduced-order mesoscale modeling strategy based on the *eigendeformation* concept.

Second, we investigate the mechanical response of titanium structures subjected to extreme thermo-chemo-mechanical environment. Extreme environment causes embrittlement, hardening and fracture within a thin boundary region of the titanium structure due to thermally activated ingress of oxygen. We propose a multiscale-multiphysics computational methodology based on the variational multiscale idea to solve this problem. The basic premise of the approach is accurate fine-scale (microstructural) representation and modeling of the coupled response at a small subdomain of the problem where it is known a-priori that important physical phenomena (e.g., fracture processes, transformation in response characteristics) are likely to occur. The response within the remainder of the problem domain is idealized based on coarse-scale (phenomenological) representation. The variational multiscale enrichment is employed to devise a multiscale, coupled oxygen diffusion – elasticity framework for analysis of titanium response under extreme environments.

NOTE: *If you are interested in meeting individually with Dr. Oskay, please contact Evelyn at 631-5431*