Positive-definite random matrix ensembles in multi-scale mechanics

Sonjoy Das, University at Buffalo (SUNY)

The scientific community has seen an increasing surge of applications of positive-definite random matrix ensembles in stochastic mechanics and stochastic multi-scale mechanics in recent years. These ensembles are employed to model *directly* many matrix-valued parameters, e.g., mass matrix, stiffness matrix, constitutive elasto-plasticity matrix. Brief review of a few positive-definite random matrix ensembles together with relevant applications in mechanics and multi-scale mechanics will be first presented in this talk. An important problem of identifying micro-anomalies *from* macro-scale response variables will be subsequently considered. By micro-anomalies, we primarily refer to micro-cracks that are not discernible by naked eyes. Initiation of fatigue damage typically starts at the sites of these micro-cracks due to fatigue cyclic loading, and may lead to catastrophic failures of structural systems. It is difficult to capture such precursory states of internal damage evolution by using sensors before they visibly appear as macro-cracks. Analysis of such micro-cracks is also beyond the scope of the conventional crack propagation analysis, e.g., fracture mechanics. This talk will discuss how this gap can be filled by having recourse to the positive-definite random matrix ensembles together with the theory of multi-scale mechanics.