Managing Stress Waves Over Multi-frequencies by Micro-architectural Design of Materials

Composite materials have been extensively used in aerospace and other structural systems due to their controllable thermomechanical attributes such as stiffness, strength, and toughness that are accompanied by their relatively low mass density. They are generally characterized and designed in terms of their quasi-static properties. It turns out that composites with suitably designed micro-architectures can have unusual dynamic behaviors, while retaining their standard structural properties.

There are a number of effective homogenization techniques that have been offered over the last several decades to calculate the overall quasi-static parameters of composites, e.g., their elastic moduli. However, these techniques have yet to be extended for calculating the overall frequency-dependent effective dynamic properties of composites. It turns out that these properties can vary broadly depending on the frequency range. In fact, the effective frequency-dependent elasticity of a composite can be coupled with its frequency-dependent effective mass-density.

In this seminar I will discuss certain basic issues regarding systematic homogenization techniques to extract the frequency-dependent dynamic properties of microstructurally periodic composites, illustrating the results in terms of measureable and experimentally verifiable quantities.