Spring 2011 Seminar

MECHANICS RESEARCH COMMUNICATIONS

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11:30 a.m. – 1:00 p.m.
Guttenberg Information Technologies Center (GITC) – Room 3730

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.

Sia Nemat-Nasser arrived in the USA in 1958 from Iran and he received a B.S. degree in Engineering in 1960 from California State University. He obtained an M.S. in civil engineering in 1961 and a Ph.D. in Engineering in 1964, both from UC Berkeley. He held a post-doctoral fellow position at Northwestern University (1964-66), junior faculty positions at UC San Diego (1966-1970), and was professor of civil engineering at Northwestern (1970-85). Sia returned to UC San Diego in 1985 as a professor, where he is currently a Distinguished Professor of Mechanics and Materials and Director of UCSD's Center of Excellence for Advanced Materials. Sia spearheaded the creation of an integrated Materials Science and Engineering Graduate Program, serving as its Founding Director (1989-1994). He was co-Director of NSF's Institute for Mechanics and Materials (1992-1997) and Director (1997-1999). His research integrates experiment, theory, and computation, currently including: multifunctional composites with tunable electromagnetic and stress-wave management functionality, thermal management, self-healing, self-sensing, and metamaterials with negative refractive index; polyelectrolytes and ionic polymer metal composites as soft actuators/sensors; shape-memory alloys; advanced metals and ceramics; elastomers; granular materials; and hybrid composites. Sia is an honorary member of ASME and a member of the National Academy of Engineering. He has received several honors and awards for his contributions to mechanics and materials, including the Timoshenko, Prager, von Karman, Nadai, and Murray Medals, and the Alburz Educational Foundation Prize 1975.

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