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MULTISCALE MODELING OF DYNAMICS IN COMPLEX MEDIA AND METAMATERIALS

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MINISYMPOSIUM

The design of material at the microscale greatly impacts its mechanical response at different observation scales and under different loading conditions. Representative Volume Elements (RVEs) have successfully been used for homogenization and multiscale modeling of materials, particularly for linear and quasi-static loading conditions. In addition to such RVE-based approaches, this minisymposium seeks homogenization and multiscale methods that address dispersive response of elastodynamic metamaterials and other microstructured media, quasi-static and dynamic response of random media, and approaches that incorporate material failure at multiple scales. Broad topics of interest are (but not limited to):

- Dynamic homogenization methods:
  - Field averaging, parameter retrieval, and effective (apparent) properties
  - Spatial dispersion and higher order methods, and Willis material
  - Effect of disorder and randomness
- Novel unit cell designs for phononic crystals and mechanical metamaterials:
  - Use of nonlinear elasticity and friction, fluid-based designs, dynamic and adaptive design.
  - Parametric and topology optimization of unit cells and graded microstructure.
  - Seismic, acoustic and vibration, and blast and ballistic applications of dispersive materials.
  - Multi-fidelity approaches to design of microstructured media
- Statistical homogenization and upscaling methods:
  - Statistical homogenization approaches that relate inherent material randomness to statistical variation of macroscopic quantities of interest both for quasi-static and dynamic regimes.
  - Effect of disorder on dynamic response of metamaterials.
- Material damage and other nonlinear effects:
  - Failure of mechanical metamaterials and other dispersive materials under dynamic loading.
  - Homogenization and multiscale schemes incorporating material failure across scales.
  - Fragmentation problems and rate effects arising from material microstructural design and failure processes.
- Numerical methods for aforementioned problems:
  - Volume-Element based multiscale methods.
  - Reduced order models.
  - Machine learning-based multiscale methods.
  - High performance computing aspects (parallel computing, high order methods, mesh adaptivity, and multi-resolution schemes).