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MODELING AND SIMULATIONS OF METAMATERIALS

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ABSTRACT

Metamaterials are engineered structures designed to exhibit exceptional properties not found in naturally occurring materials. Their unique macroscopic behaviors—ranging from negative Poisson's ratios to acoustic cloaking and tunable electromagnetic responses—stem from their intricate microstructural architectures. As the geometric and functional complexity of these architectures grows, empirical trial-and-error approaches to their design have become increasingly unfeasible. Consequently, advanced numerical modeling is essential to accurately predict, control, and optimize their performance.

This Mini symposium explores the critical role of numerical simulations in the design and analysis of architected metamaterials. To accurately capture the complex, synergistic phenomena that govern these materials across multiple scales, researchers must move beyond isolated physical models. We invite contributions that discuss novel computational methods, multiscale homogenization techniques, data-driven modeling, and the experimental validation of numerical frameworks for metamaterial design.

Numerical simulations enable the design of metamaterials for highly specific, complex environments. The session will highlight the latest advancements in integrated modeling frameworks, including, but not limited to:

- Large strain modeling
- Plasticity and viscoplasticity in metamaterials
- FSI models
- Biomechanical implants
- Electromechanical models
- Thermomechanical models