Computational Multiscale Mechanics Laboratory (CMML)

Meshfree Particle Methods (Macro-scale ~1m)

- Deformations and fractures
- Stability Analysis
- A coupling method of meshfree particle method with finite element method

Meshfree particle method coupled with FEM for 3D crack propagation

Shock Wave Propagation (Macro-scale ~1m)

- The flux-corrected transport (FCT) algorithm is implemented to eliminate the fluctuations behind shock wave fronts
- Precisely describe shock wave propagation and interaction
- Accurately predict spallation

FE method

FE-FCT method

Topological Optimization (Meso-scale ~1mm)

- Structured extended finite element method
- An implicit function is used to describe the boundary

Topological Optimization

Temperature-Related Homogenization (Micro-scale ~1μm)

- Temperature-related Cauchy-Born (TCB) rule
- Verifications and material stability analysis

![Graphs showing Cauchy stresses vs. temperature](image)


Multiscale Methods (Micro/Nano-scales ~1μm-1nm)

- Bridging domain coupling method
- Nanoscale meshfree particle method

![Graph showing crack speed vs. time](image)

Nanotubes and Nanocomposites (Nano-scale ~1nm)

- Size effects on carbon nanotubes’ mechanical properties
- Mechanics of Defect-free and defective carbon nanotubes
- Reliability analysis of nanotubes
- Mechanics of nanotube-based composites
- Molecular dynamics and multiscale simulations

Nanotube-Based Devices (Nano-scale ~1nm)

- Nanotube-based co-axial oscillators
- Nanotube-based resonant oscillators
- Nanotube-based memory cell
- Molecular dynamics and multiscale simulations