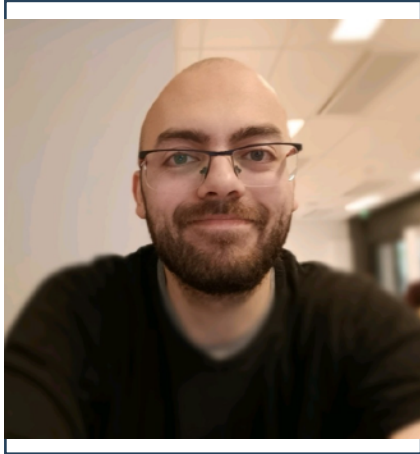


EME International Seminar Series



Bottom-up mechanical modeling of cellular structures

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Abstract:

I will present a two-dimensional numerical model to simulate the dynamics of deformable core-shell particles and the damage of cellular tissues. Particle surfaces are represented by a shell of mass points linked by elasto-plastic laws that govern surface stretching and bending, while a homogeneous core imposes a volumetric stiffness. After calibration and verification, we study the bulk uniaxial compaction of assemblies and show that faceting - controlled by core stiffness and shell plasticity - is the principal mechanism of void reduction: polygonal shapes dominate at low plasticity, elongated shapes at high plasticity, with an intermediate phase characterized by higher porosity. The void-to-confinement ratio follows a logarithmic law whose prefactor depends strongly on the collective plasticity. Finally, by generating tissues via an optimisation algorithm based on Voronoi tessellation and introducing an energy-based criterion for intercellular rupture, we demonstrate that tensile strength scales with a characteristic stress and decreases with structural disorder; cracks circumvent high-density regions, thereby increasing the fracture surface area.

Thursday, 4 June 2026 16:00 – 17:00, 3F400

Degree Program in Engineering Mechanics and Energy
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