DEPARTMENT OF MATHEMATICAL SCIENCES

Colloquium

Yuehui Xu

WPI

Title: A geometry-dependent, force-balance driven model of biofilm cell cluster detachment

Abstract: Biofilms are bacterial communities embedded in extracellular polymeric substance (EPS) matrices that form on medical devices and industrial surfaces. We present a multiscale modeling framework that predicts biofilm detachment by coupling stochastic agent-based microstructure to cluster-level mechanics. Using iDynoMiCS simulation, we generate realistic biofilms and identify candidate detachment clusters based on local EPS disruption and spatial density. Detachment is decided by a geometry-dependent moment balance: clusters detach when hydrodynamic drag moment exceeds adhesive moment. Our results show that EPS disruption accelerates removal, larger clusters are more elongated, and initial biofilm structure influences detachment statistics. The model predicts distributions of detached cluster size and shape, providing a reusable framework for understanding biofilm control across species and conditions.

Friday, November 6

11:00 – 12:00 pm

Stratton 202

WPI