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Title: Biogels as climate-resilient soil stabilization materials

Date: 23rd December, 2024

Time: 11:00 AM to 12:00 PM

Venue: LG-03, Central Learning Theatre (CLT), Permanent Campus, IIT Dharwad

Mode: Hybrid (In-person & Online)

Abstract: Recent advancements in bioremediation in geotechnical engineering have introduced biogels as a replacement for pore water in soil, significantly enhancing the physical and hydraulic properties. This approach addresses critical challenges posed by climate change, including freeze-thaw damage and soil stability issues. By mitigating soil erosion, reducing swelling, and improving foundation stability, biogels represent a promising solution for sustainable infrastructure. However, identifying the optimal biopolymer additive—one that enhances performance without compromising soil strength—remains a complex challenge. Ideal biogels should be self-assembling, resilient to deformation, and capable of integrating clay additives to maximize efficacy. While experimental efforts have demonstrated promising results, they largely rely on trial and error to determine the appropriate biopolymer composition and clay filler properties. This study employs computational modeling to systematically evaluate biogel systems composed of polymer chains and clay nanoplatelets in an explicit solvent. Using coarse-grained molecular dynamics simulations, we investigate how clay filler structure, concentration, and polymer-polymer interactions influence the mechanical and structural properties of biogels. Our findings reveal a spectrum of network morphologies, from interpenetrating polymer systems to single-chain networks, achieved by modulating polymer-polymer interactions. Additionally, we simulate ice formation in the presence of biogels to assess their potential to prevent freeze-thaw damage. These insights provide a foundation for designing tailored biopolymer-based pore fluids, advancing their application in bio-geotechnical engineering. By enabling more resilient soil systems, this research contributes to the development of sustainable and climate-adaptive infrastructure.



Speaker: Prof. Dilip Gersappe

Bio: Professor and current chair of MSCE department at Stony Brook University, New York, USA. He received his PhD from Northwestern University, USA. He was a postdoc at the University of Pittsburgh and Johns Hopkins University.