Polymer Seminar

11:15 am, January 30, 2026

Science 1 - room 1002

Host: Anson Ma

Safa Jamali

Associate Professor, Mechanical & Industrial Engr.

Northeastern University

Physics-Informed Data-Driven Frameworks for Rheological Applications

Abstract: The ability to concisely describe the dynamical behavior of soft materials through closed form constitutive relations holds the key to accelerated and informed design of materials and processes. The conventional approach is to construct constitutive relations through simplifying assumptions and approximating the time- and rate-dependent stress response of a complex fluid to an imposed deformation. Once the constitutive model is available, it's usually solved numerically for other flow geometries and kinematics. While traditional frameworks have been foundational to our current understanding of soft materials, they often face a two-fold existential limitation: (i) constructed on ideal and generalized assumptions, precise recovery of material-specific details is usually serendipitous, if possible, and (ii) inherent biases that are involved by making those assumptions commonly come at the cost of new physical insight. I will present a wide spectrum of data-driven frameworks that can help both develop and solve the new generation of constitutive models for soft materials. These are generally methods that involve combination of statistical inference formalisms, with the addition of physical intuition. These physical intuitions can come in form of low fidelity data or model predictions; but the overall result is the same: combination of data-driven predictions and physical intuition clearly opens new horizons for constitutive model detection, discovery, and simulation.

Bio: I am an Associate Professor of Mechanical and Industrial Engineering at Northeastern University. I received my PhD from Case Western Reserve University's Macromolecular Science department, followed by two years of Postdoc training at MIT's Chemical Engineering, Mechanical Engineering and Energy Initiative, and then joined Northeastern University in 2017. My research group is focused on developing and using a series of data driven and computational methods for physics and rheology of complex materials. These include biophysics of cell suspensions with focus on blood dynamics, science-based data-driven methods and machine-learning platforms for rheological applications, and physics of colloidal systems amongst other topics.

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