MAE Seminar Series

Tuesday,
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3:30 PM
Furnas 206

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Particles In Flow: Computational Insights Into The Rich Dynamics Of Particle Systems, With Applications In Manufacturing And Biomechanics.

ABSTRACT

Particles comprise a key ingredient in a multitude of modern engineering applications, which includes the growing variety of particle-based approaches in computational engineering as well. The collective interactions of a system of particles lead to a very rich set of dynamic behavior. Fundamental advances in understanding this behavior have enabled the development of innovative computational tools for challenging real-world applications ranging from industrial to physiological domains. The focus of this seminar will be on particles in flow, which I will interpret in two distinct modalities – namely, particles in a state of flow due to their interactions (a) with each other, and (b) with a background fluid flow. First, the case of a system of particles in a state of flow due to mechanical interactions with each other will be discussed. I will demonstrate the development of computational tools to resolve such interactions, and employ these tools for multi-physics modeling of particulate spray deposition processes commonly encountered in advanced manufacturing applications. Next, I will consider the case of particles embedded or dispersed within a complex background fluid flow. This will be discussed using examples drawn from cardiovascular biomechanics, where large artery hemodynamics constitutes the background flow. I will illustrate the development of computational tools based on an innovative combination of medical image/data driven modeling, computational fluid dynamics, and discrete particle mechanics, to understand the hemodynamic underpinnings of cardiovascular diseases like stroke and thrombosis. The computational approaches and mechanistic insights generated from these investigations enable exploring some of the commonalities between, and addressing key existing challenges in, the application domains of advanced manufacturing and cardiovascular biomechanics. The seminar will close with a brief discussion on current and future research directions on how the emergent dynamics of particle systems can be used to understand, and engineer, complex systems.

BIO SKETCH

Dr. Debanjan Mukherjee is an American Heart Association post-doctoral fellow in the Department of Mechanical Engineering at the University of California, Berkeley. Prior to this he completed is MS and PhD from the University of California, Berkeley, and a B.Tech from the Indian Institute of Technology, Madras, India. His research interests lie at the interface of fluid mechanics and computational mechanics, with a focus on multi-scale multi-physics modeling and simulation of complex flow phenomena. Application areas of interest include cardiovascular biomechanics and biomedicine, and multi-physics phenomena in advanced manufacturing processes. Outside of work, Dr. Mukherjee is an avid music enthusiast and performer, and enjoys trying his hand at cooking new recipes.

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