VANDERBILT
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DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

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Via Zoom

"NEURAL OPERATORS AND BEYOND – THE CHANGING LANDSCAPE OF SCIENTIFIC COMPUTING"

DR. SOUVIK CHAKRABORTY

ASSISTANT PROFESSOR, DEPT. OF APPLIED MECHANICS
INDIAN INSTITUTE OF TECHNOLOGY, DELHI, HAUZ KHAS INDIA

ABSTRACT

Operator learning is an emerging area in scientific machine learning which aims to learn mappings between infinite dimensional function spaces. In the first half of the talk, I will delve into the foundations of Wavelet Neural Operator (WNO), a recently developed operator learning algorithm. I will discuss its working principles and its potential applications in complex engineering problems including fracture propagation in brittle materials, tumor detection using USG data and elastography, and climate modelling.

The second half of the talk will focus on what lies beyond neural operators. I will introduce a new scientific machine learning architecture that is loosely motivated from cognitive science. This architecture is a first of its kind foundation model and offers two key advantages: (i) it can simultaneously learn solution operators for multiple parametric PDEs, and (ii) rapid generalization to new parametric PDEs with minimal fine-tuning. We observe that the proposed architecture is robust against catastrophic forgetting and facilitate knowledge transfer across dissimilar tasks. Across a diverse array of mechanics problems, consistent performance enhancements are observed with this architecture compared to task-specific baseline operator learning frameworks.

BIOGRAPHY

Souvik Chakraborty is Assistant Professor at the Department of Applied Mechanics, Indian Institute of Technology (IIT) Delhi, India. He also holds a joint appointment at the Yardi School of Artificial Intelligence. Souvik's research stands on three fundamental footings: Artificial Intelligence, probabilistic methods, and computational mechanics, with a particular focus on development of efficient scientific machine-learning frameworks and algorithms for high-dimensional engineering systems.

Souvik Chakraborty is recipient of number of awards including the prestigious INAE Young Engineer's award, Mrs. Veena Arora Early Career Faculty Research Award, and the Fulbright-Nehru Academic & Professional Excellence Fellowship. Souvik Chakraborty completed his Ph.D. at IIT Roorkee, India. Prior to joining IIT Delhi, he spent two years at the University of Notre Dame, USA. He also spent time as a postdoctoral researcher at the University of British Columbia, Canada.

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