MECHANICAL & MATERIAL COLLOQUIUM

Flow Control and Analysis using Deep Learning Techniques

by Siddhartha Verma (Ocean and Mechanical Engineering, Florida Atlantic University)

'Artificial Intelligence' has made tremendous gains in recent years, and it is increasingly finding promising uses in various practical and scientific applications. But despite our optimistic outlook, the underlying algorithms do not possess 'intelligence' in the true sense of the word. Instead, they are exceptionally adept at identifying non-linear patterns in high-dimensional datasets. I will highlight how we have leveraged such algorithms to discover optimal control laws in extremely complex systems, especially when effective rules may not be evident a-priori. By coupling autonomous control algorithms with high-fidelity simulations of fish swimming, we have demonstrated that locomotion in schooling formations can lead to energy savings when individual fish interact judiciously with their companions' unsteady wakes. Adopting a reverse engineering approach has allowed us to understand how these autonomous decisions are driven by flow physics on a fundamental level. I will also highlight other work where deep learning techniques are used to accurately identify energetically important extreme events in wall-bounded turbulent flows. Importantly, these techniques allow us to focus on inverse problems, where dynamically important 3D coherent structures are revealed in a completely data-driven manner.

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Dr. Siddhartha Verma received his bachelor's degree in Aerospace Engineering from Georgia Tech in 2009 and a doctorate in Aeronautical Engineering from Caltech in 2014. For his graduate work he studied the turbulent transport of low-diffusivity particles using high-fidelity simulations. After completing his PhD, he moved to ETH Zurich as a postdoctoral scholar, where he combined simulations of bioinspired locomotion with optimization and machine learning techniques to better understand the interplay between fluid mechanics and decision-making in coordinated groups. Dr. Verma is currently a faculty member in the Ocean and Mechanical Engineering department at the Florida Atlantic University.
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EC 1113

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2:00-3:15 PM
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https://mme.fiu.edu/seminar-schedule

For questions, comments and suggestions, contact Colloquium Organizers Dr. Benjamin Boesl (bboesl@fiu.edu) or Dr. Jiuhua Chen (chenj@fiu.edu)