ME Seminar

Plastrons, Polymers, and Textiles: Fluid-Based Solutions for Real-World Challenges

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ABSTRACT

Fluid-based systems are ubiquitous in modern engineering, offering multiple avenues for technological innovation that confer benefits to both people and our planet. For example, skin friction from the turbulent boundary layer accounts for over 50% of the total drag on ships, and the corresponding CO2 emissions from the shipping industry exceeded one billion tonnes in 2018. In the first half of the talk, we explore polymers and superhydrophobic coatings as potential methods for drag reduction in marine applications. We show that interfacial activity of the dissolved polymer chains plays a decisive role in determining the success of combining these two techniques for enhanced drag reduction, and we further develop a semi-empirical model to quantify the additive drag reduction effect.

The second half of the talk focuses on a different application area which also benefits from an in-depth understanding of fluid flows, namely, the use of textile-based pneumatic wearables as comfortable, lightweight, and low-cost assistive devices for people with disabilities and mobility limitations. For context, over half a million people in India reported a movement disability in 2011. We develop a fully textile platform for embedding fluidic digital logic in wearable devices, with the goal of augmenting or replacing existing control systems that rely on rigid electronic computers and electromechanical valves. Our textile-based fluidic computer is compliant and washable, can be integrated into regular clothing, and may be used to control assistive actuators based on user input, thereby enabling future generations of low cost, electronics-free robotic wearables.

ABOUT THE SPEAKER

Anoop obtained his B.Tech. in mechanical engineering at the Indian Institute of Technology Madras in 2015 and his S.M. and Sc.D. at the Massachusetts Institute of Technology in 2017 and 2020, respectively. He is currently a junior postdoctoral fellow in the Rice Academy of Fellows, conducting research in the Department of Mechanical Engineering at Rice University, Houston, Texas, USA. His research interests include superhydrophobic surfaces, turbulent drag reduction using polymers, textile-based assistive wearable robots, and thermo-rheological characterization of elastomers.

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