The Department of Mechanical Engineering/College of Engineering and Applied Sciences
Stony Brook University

Mechanical Engineering Seminar

Faculty Candidate

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Lecture Title: Transport Phenomena over Patterned Surfaces

Thursday May 2, 2013 at 2PM, Room 173 Light Engineering Building

Abstract

Coupled flows over patterned surfaces occur in a variety of natural phenomena, biological systems and industrial processes. By treating the patterned surface as a permeable layer, we formulate a system of coupled Navier-Stokes/Brinkman equations, which is amenable of analytical solution for the mean filtration velocity inside the pattern. The latter is used to derive self-similar velocity and shear profiles by means of intermediate asymptotic analysis in the limit of infinitely small permeability, and for both laminar and turbulent regimes over the permeable layer. We show that a spatial length scale, related to the pattern thickness, naturally emerges from the limiting process and suggests a more formal definition of thin and thick permeable layer. Finally, we employ this effective-medium framework to model channel turbulent flows over 1) arrays of carbon nanotubes, which can freely deflect under the shear exerted by the fluid flowing through and over the forest [1,2], and 2) superhydrophobic ridged surfaces [3]. The model predictions agree with laboratory experiments for a large range of channel velocities.

Biography

Dr. Battiato received a MS (equiv.) in environmental engineering with highest honors at the Politecnico di Milano, Italy, in 2005. Subsequently she obtained a MS in engineering physics and a PhD in engineering science with specialization in computational sciences from University of California San Diego in 2008 and 2010, respectively. She held a postdoctoral position at the Max Planck Institute for Dynamics and Self-Organization in Goettingen, Germany, and was a visiting fellow at the Statistical and Applied Mathematical Sciences Institute (SAMSI) in Research Triangle Park, NC. In 2012, she joined the faculty at the Mechanical Engineering department at Clemson University.

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