APPLIED MATHEMATICS COLLOQUIUM:
Two short analytical stories: (1) Thin films, an edge, and a novel similarity solution and (2) A new look at ODEs and resonance

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Date:
2/12/2021

Time:
3:00 PM-4:20 PM

Link:
Please contact snsgradstaff@ucmerced.edu for the Zoom link and passcode.

About The Speaker:

Professor Howard A. Stone received the Bachelor of Science degree in Chemical Engineering from the University of California at Davis in 1982 and the PhD in Chemical Engineering from Caltech in 1988. Following a postdoctoral year in the Department of Applied Mathematics and Theoretical Physics at the University of Cambridge, in 1989 Howard joined the faculty of the (now) School of Engineering and Applied Sciences at Harvard University, where he eventually became the Vicky Joseph Professor of Engineering and Applied Mathematics. In 2000 he was named a Harvard College Professor for his contributions to undergraduate education. In July 2009 Howard moved to Princeton University where he is Donald R. Dixon '69 and Elizabeth W. Dixon Professor in Mechanical and Aerospace Engineering

Professor Stone's research interests are in fluid dynamics, especially as they arise in research and applications at the interface of engineering, chemistry, physics, and biology. He is a Fellow of the American Physical Society (APS), and is past Chair of the Division of Fluid Dynamics of the APS. He is currently on the editorial or advisory boards of Physical Review Fluids, Langmuir, and Soft Matter, and is co-editor of the Soft Matter Book Series. He is the first recipient of the G.K. Batchelor Prize in Fluid Dynamics (2008). He was elected to the National Academy of Engineering in 2009, the American Academy of Arts and Sciences in 2011 and the National Academy of Sciences in 2014.

Abstract:

I discuss two recent projects where new analytical results are obtained in problems with classical features. In the first example, we document experimentally the time and (three-dimensional) space variations of the shape of a falling film near the edge of a vertical plate and rationalize the quantitative features using a similarity solution. This example seems unusual since we are able to theoretically show that the shape is described by a nonlinear partial differential equation, involving three independent variables, yet the equation can be reduced by a similarity transformation to a nonlinear ordinary differential equation. The results are in excellent agreement with the experimental measurements. Second, we present a new look at the classical question of obtaining solutions to linear ODEs forced at resonance, or the closely related problem where the linear operator has the equivalent of "repeated roots." We obtain a new analytical structure that is more insightful and less tedious than standard methods such as reduction of order or variation of parameters. The ideas can be introduced at the undergraduate level, but we are not aware of any elementary or advanced text that illustrates these ideas with appropriate generality.

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