Johns Hopkins University
Department of Mechanical Engineering
2021 Spring Virtual Seminar Series: Class 530.803

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REGISTRATION LINK | **ZOOM LINK** | **Passcode:** 446835

"Fluid Dynamics of Speech: Mechanisms Underlying COVID-19 Transmission"

Presented by Professor Howard Stone

Donald R. Dixon '69 and Elizabeth W. Dixon Professor in Mechanical and Aerospace Engineering
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Speech is a potent route for viral transmission in the COVID-19 pandemic. Informed mitigation strategies are difficult to develop since the relationship of speech to the exhaled flow has not been documented, nor has the aerosolization mechanism in the oral cavity been visualized. We document the spatio-temporal structure of the expelled air flow and detail how drops form using high-speed imaging. Specifically, phonetic characteristics of plosive sounds like `P' lead to enhanced directed transport, including jet-like flows that entrain the surrounding air. The transport features are demonstrated using order-of-magnitudes estimates, numerical simulations, and laboratory experiments. Different configurations of speakers can then be studied to understand risk of infection in casual conversations.

Also, we show with high-speed imaging how phonation of common stop-consonants form and extend viscoelastic salivary filaments in a few milliseconds as moist lips open or when the tongue separates from the teeth, which produces centimeter-scale thin filaments, tens of microns in diameter, that break into speech droplets. We believe that this work will inform thinking about the role of ventilation, aerosol transport in disease transmission for humans and other animals, and yield a better understanding of "aerophonetics".

Professor Howard A. Stone received degrees in Chemical Engineering from UC Davis in 1982 (BS) and Caltech in 1988 (PhD). Following a postdoc at the University of Cambridge, in 1989 he 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 the first recipient of the G.K. Batchelor Prize in Fluid Dynamics (2008) and received the Fluid Dynamics Prize of the APS in 2016. 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.