



SANTA CLARA UNIVERSITY

Department of Mechanical Engineering

Mechanical Engineering Seminar Series

Human Phonation: Fluid Dynamics of Speech Production

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Date: Wednesday, March 8, 2017

Time: 4:00 – 5:00 pm

Location: Bannan Engineering, EC 326

Abstract

Speech production involves unsteady pulsatile flow and turbulent structures that affect the aeroacoustics and fluid-tissue interaction. The goal of our human phonation research program is to investigate the dynamics of flow past the vocal folds (VF) and the aerodynamic interaction with the VF. Silicone-based, self-oscillating synthetic vocal fold (VF) models are fabricated with material properties representative of the different layers of human VFs and then evaluated experimentally in a life-size vocal tract simulator to replicate physiological conditions. Our experimental investigations utilize high-speed imaging, particle image velocimetry (PIV), pressure transducers and microphones, and the clinical Rothenberg mask. Studies are performed under both normal and pathological conditions of speech. In particular, recent attention has been focused on understanding the role of polyps (growths on the VF) in altering voice quality. This has led to very fundamental studies of 3D flow separation in pulsatile flows. We have also collaborated with colleagues in the Department of Speech and Hearing Sciences to better understand the effects of ageing on voice. Our overarching motivation for studying flow associated with phonation is to facilitate evaluation and design of treatment interventions and for surgical planning, i.e. to enable physicians to assess the outcomes of surgical procedures by using faithful computer simulations. Such simulations are on the horizon with the advent of increasingly more powerful high performance computing and cyberinfrastructure, but they still lack many of the necessary physical models. We also seek to inform non-surgical clinical treatment strategies of voice disorders.

Biography

Dr. Michael W. Plesniak is Professor and Chair of the Department of Mechanical & Aerospace Engineering at the George Washington University, with a secondary appointment in the Department of Biomedical Engineering. He was formerly Professor of Mechanical Engineering at Purdue University and *Eugene Kleiner Professor for Innovation in Mechanical Engineering* at Polytechnic University in Brooklyn, NY. He served as the Director of the Fluid Dynamics & Hydraulics program at the National Science Foundation from 2002-2006. Prof. Plesniak earned his Ph.D. degree from Stanford University, and his M.S. and B.S. degrees from the Illinois Institute of Technology; all in Mechanical Engineering. Dr. Plesniak is a Fellow of AIAA, ASME, the *American Physical Society (APS)*, the *American Institute for Medical and Biological Engineering (AIMBE)* and the *Association for the Advancement of Science (AAAS)*. He has authored over two hundred fifty refereed archival publications, conference papers and presentations. He has presented numerous invited seminars and keynote addresses. His research group is currently studying the physics of phonation and cardiovascular flows. Dr. Plesniak is the Director of GW's *Center for Biomimetics and Bioinspired Engineering*. Prof. Plesniak was a recipient of the *2017 ASME Fluids Engineering Award*, the *2011 NASA DC Space Grant Consortium's Outstanding STEM Faculty Award*, awarded



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to faculty that *make an outstanding contribution to STEM that goes above and beyond the classroom*. Dr. Plesniak was also named the American Institute for Aeronautics and Astronautics, National Capital Section *Engineer of the Year 2010-2011*.