

iHealthtech Seminar

17 JUN, WED, 11:00 AM–12:00 PM

NUS, College of Design and Engineering, Building E7, Level 3, Seminar Room 3



Dr Wang Cong

Assistant Professor of Mechanical Engineering,
University of Iowa, USA



Fluid Mechanics of Cough Clearance: Simulating the Transient Dynamics of Airway Mucus Expulsion



Hosted by: Dr Wu Changsheng, iHealthtech Principal Investigator

Coughing is the respiratory system's primary mechanical defense, expelling mucus-entrapped pathogens from the airway through a sub-second burst of high-velocity airflow. Defective cough clearance drives morbidity in cystic fibrosis, Chronic Obstructive Pulmonary Disease (COPD), and neuromuscular diseases. Despite its clinical importance, the physics governing mucus clearance remains fundamentally uncharacterized, rendering challenges in clinic result interpretation and limited efficiency of medical solutions. This talk presents our recent development of a mechanical cough simulation platform that replicates the physiologically realistic pressure and flow environment of human coughing and huffing, i.e., peak pressure transient (~ 3 – 5 Psi), peak flow rate (6–12 L/s), and sub 0.1 second rise time. Using banana slug mucus as a physiological analog with tunable rheological properties, we have observed and characterized distinct mucus clearance modes as a function of viscoelasticity and surface adhesion, including wave-driven crawling, peeling-detachment, and fragmentation. High-speed imaging and mucus motion visualization reveals that mucus clearance is a complex interplay between viscoelastic mucus, lubrication layer, and pulsatile airflow. Preliminary time-resolved velocity and strain rate fields extracted by Particle Tracking Velocimetry will be presented. The observation and analysis have potential to inform clinic interpretation and rational design of mucolytic therapies.

Speaker biography:

Dr Cong Wang is an Assistant Professor of Mechanical Engineering at the University of Iowa. His research program focuses on multi-phase flow physics, flow diagnostics, and fluid-structure interaction, with applications in naval hydrodynamics and respiratory biomechanics. He got his B. Eng degree in Engineering Science from the National University of Singapore in 2013, and his Master and Ph.D. degree in Aeronautics from Caltech in 2014 and 2019, respectively. He held positions as Postdoctoral Associate and Research Scientist at Caltech before joining University of Iowa in 2023. Dr Cong Wang was recipient of Don Coles Prize and Ernest E. Sechler Memorial Award in Aeronautics from Caltech. Dr Wang's research is supported by Office of Naval Research and Department of Transportation of the United States.

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