Stony Brook University

Department of Civil Engineering

FALL 2021 SEMINAR SERIES

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Monday, August 30, 1:00 – 1:55 PM, Frey Hall 309

ZOOM LINK: Meeting ID: 950 8981 9867; Passcode: 860265
https://stonybrook.zoom.us/j/95089819867?pwd=NzdKQUJXU3J3NFN4VlpBUlp4bDFhUT09

A computational study of expiratory particle transport during coughing and normal breathing with and without face masks

Abstract

The coronavirus disease outbreak of 2019 has been causing significant loss of life and unprecedented economic loss throughout the world. Social distancing and face masks are widely recommended around the globe to protect others and prevent the spread of the virus through breathing, coughing, and sneezing. To expand the scientific underpinnings of such recommendations, we carry out high-fidelity computational fluid dynamics simulations of unprecedented resolution and realism to elucidate the underlying physics of saliva particulate transport during human cough and breathing with and without facial masks. Our simulations (a) are carried out under both a stagnant ambient flow (indoor) and a mild unidirectional breeze (outdoor), (b) incorporate the effect of human anatomy on the flow, (c) account for both medical and non-medical grade masks, and (d) consider a wide spectrum of particulate sizes, ranging from 0.1 μm to 300 μm. We show that during indoor coughing some saliva particulates could travel up to 0.48 m, 0.73 m, and 2.62 m for the cases with medical grade, non-medical grade, and without facial masks, respectively. Also, our study elucidates the vorticity dynamics of human breathing and show that without a facile mask, saliva particulates could travel over 2.2 m away from the person. However, a non-medical grade face mask can drastically reduce saliva particulate propagation to 0.72 m away from the person. This study provides new quantitative evidence that facile masks can successfully suppress the spreading of saliva particulates due to coughing normal breathing in indoor environments.

About the Speaker:

Dr. Khosronejad's research interests consist of three interconnected areas: (1) Development of high–performance computing tools, (2) Application of simulation–based engineering tools, and (3) simulation-driven experimentation and physics-driven computational modeling. Dr. Khosronejad's research is supported, among others, by the California Department of Transportation (Caltrans), the National Science Foundation (NSF), the National Institute of Health (NIH) and the Department of Energy (DOE). Prior to joining Stony Brook as an assistant professor, Dr. Khosronejad was a Research Associate at St. Anthony Falls Laboratory at the University of Minnesota. He obtained his Ph.D. degree in civil engineering (Hydraulic Engineering) from Tarbiat Modares University in Tehran, Iran.