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臺灣大學應用力學研究所

演 講 公 告

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主 講 人：陳銘昌副教授
University at Buffalo, The State University of New York

講　　題：Multiscale Study of Hypersonics: Turbulence and Ceramics

摘　　要：　如附件

主 持 人：　陳瑞琳教授

時　　間：　114年10月13日（星期一）下午2時20分開始

地　　點：　臺灣大學應用力學研究所國際會議廳

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Multiscale Study of Hypersonics: Turbulence and Ceramics

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Abstract: Recent technology development for hypersonic applications has posed several challenges for fluids and solids. This seminar showcases a gallery of the speaker's multiscale study for hypersonics, including the intrinsic angular momentum coupled with linear momentum for high-speed flows and a manufacturing-driven integrated computational materials engineering (ICME) framework with a four-way thermo-mechanical fracture model for ceramic materials. The coupling between the intrinsic angular momentum and the hydrodynamic linear momentum has been known to be prominent in fluid flows involving physics across multiple length and time scales, *e.g.* turbulence, nonequilibrium flows and flows at micro-/nano-scale. One of the proposed efforts is the morphing continuum theory (MCT), reformulated by the speaker through kinetic theory and the Boltzmann-Curtiss formulations. The multiscale nature of MCT allows one to observe the separate routes of energy transfer during the cascade phenomena. Several cases, including homogeneous isotropic turbulence, supersonic turbulence over a compression ramp and flows with translational nonequilibrium, will be presented. The second part of the talk will discuss an uncertainty informed ICME framework for ceramics. The experimentally validated framework is formulated from few known manufacturing processes, *e.g.* direct ink writing and chemical vapor infiltration, and extends to performance analysis with a four-way coupling algorithm through numerical simulations. The speaker will also discuss data-driven tools with Bayesian statistics and artificial neural network (ANN) for data sustainability. The speaker will demonstrate the modified G-criterion, Bayesian updated flexure strength with managed uncertainty and ANN-based algorithm for flexural strength all for α-SiC at a wide range of temperatures ($20^oC - 1400^oC$).

Bio: Dr. James M. Chen is an Associate Professor in the Department of Mechanical and Aerospace

Engineering at University at Buffalo (UB). He earned his Ph.D. in mechanical and aerospace engineering with a minor in applied mathematics at The George Washington University (2011). Prior to joining UB, He was an Assistant Professor and the endowed Steve Hsu Keystone Scholar at Kansas State University (2015-2018). He has published 50+ peer-reviewed journal articles in multiscale computational mechanics, theoretical & computational fluid dynamics and atomistic simulation for thermo-electro-mechanical coupling. He received the Young Investigator Award from AFOSR in 2017, the Outstanding Young Engineer Award from the Wichita Council of Engineering Societies in 2018 and the Rising Star Award from the Electrostatics Society of America in 2021. His research at MCPL has been supported by DoD, DoE, NSF and NASA and recognized by numerous media outlets, including a feature article in Aerospace Testing International (UK), and a radio show in Austria. Recently, his research team at MCPL won the Who's Who competition by ASME FEDSM in 2024. His current interests are on compressible turbulence, supersonic/hypersonic flow physics, high temperature ceramics matrix composite, uncertainty quantification and data science. He is a Fellow of ASME and an Associate Fellow of AIAA.