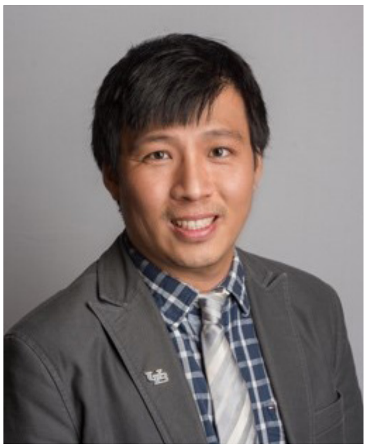
UNIVERSITY OF MARYLAND

THE BURGERS PROGRAM FOR FLUID DYNAMICS
FLUID DYNAMICS REVIEWS SEMINAR SERIES

MULTISCALE ENERGY TRANSFER WITHIN TURBULENCE



Friday, September 13, 2019 | 11am - 12pm
2164 Martin Hall, DeWALT Seminar Room

Guest Speaker

DR. JAMES M. CHEN

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ABSTRACT

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. Since the classical Navier-Stokes (NS) equations and Boltzmann's kinetic theory are derived on the basis of monatomic gases or volumeless points, efforts to derive constitutive equations involving intrinsic rotation for fluids have been found since the 1960s. One of the proposed efforts is the morphing continuum theory (MCT), reformulated by the speaker through kinetic theory and the Boltzmann-Curtiss formulations. The kinetic nature of MCT will be briefly introduced in this talk. The multiscale nature of MCT allows one to observe the separate routes of energy transfer during the cascade. The direct relations between MCT and NS will also be discussed. Several cases will be presented in this seminar. The first one is the homogeneous isotropic turbulence, which focuses on the energy routes and their physical meanings. MCT predicts a similar energy decay rate as that in the NS-based DNS, and the detailed energy transfer through different routes are presented. The second case is a supersonic turbulence over a compression ramp, where the results are compared with the experimental measurements and the energy analysis can be used to establish turbulence models. The last case is a transonic turbulence over an axisymmetric hill, which compares the computational cost of MCT-based DNS with that of the NS-based DNS. The simulation shows that MCT only requires a mesh number an order less than that used in a NS-based study while providing a better prediction on the pressure profile.

BIO

Dr. James M. Chen is an Assistant Professor in the Department of Mechanical and Aerospace Engineering at University at Buffalo (UB). He earned his B.S. at National Chung-Hsing University (2000), M.S. at National Taiwan University (2005) and Ph.D. in mechanical and aerospace engineering and applied mathematics (minor) 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) and an Assistant Professor at the Pennsylvania State University system. He has published more than 30 peer-reviewed journal articles in multiscale computational mechanics, fracture mechanics, theoretical & computational fluid dynamics and atomistic simulation for thermo-electro-mechanical coupling. He received the Young Investigator Award from Air Force Office of Scientific Research in 2017 and the Outstanding Young Engineer Award from the Wichita Council of Engineering Societies in 2018. His research at MCPL has been supported by AFOSR, NSF and NASA and recognized by numerous media outlets, including NSF, EurekAlert, Science Daily and a radio show in Austria. His current interests are on continuum mechanics, compressible turbulence, supersonic/hypersonic flows, atomistic electrodynamics, fracture mechanics, triboelectricity and high-level programming.

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