PURDUE UNIVERSITY | School of Aeronautics and Astronautics and Mechanical Engineering

Ryan Houim

Associate Professor

Department of Mechanical and Aerospace Engineering, University of Florida, Gainesville, FL

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https://purdue-edu.zoom.us/j/93254724414?pwd=plxAsfoQMIVigPOklyMwH2j938u5Wi.1

Numerical Simulation of Post-Detonation Multiphase Flows

Abstract:

Multiphase explosions and post-detonation flows have been significant hazards for centuries, plaguing humankind ever since we have been storing small grains. Despite their long history of study and application to engineering and the military, multiphase explosions remain poorly understood. They are highly transient and involve nonlinear coupling between many different physical processes across a wide range of length and time scales. In particular, the interactions between shock waves, particle dispersal and burning, turbulence, and afterburning fuel-rich fireball gases have been longstanding questions in post-detonation flows. This presentation discusses a simulation effort aimed at understanding post-detonation multiphase flows and the development of numerical algorithms that enable them. The governing equations are described by a three-phase approach that couples explosive detonation, a compressible reactive gas with detailed chemistry, and an Eulerian kinetic-theory granular flow model. Surprising results indicate that the afterburning of turbulent post-detonation fireballs transitions from a finite-rate chemistry regime at laboratory scales to a mixing-limited regime for larger explosive charges. Results for explosively-dispersed aluminum particles show a rich variety of ignition and combustion mechanisms that qualitatively explain experimental observations. The presentation will close with a brief discussion of our latest efforts to simulate the effect of polydisperse size distributions on the combustion dynamics of explosively-dispersed reactive particles.

Biography:

Professor Houim received a B.S degree in Mechanical Engineering from North Dakota State University in 2004 and a Ph.D. degree in Mechanical Engineering from the Pennsylvania State University in 2011. He was a awarded a National Research Council Post-Doctoral fellow at The Laboratories for Computational Physics at the Naval Research Laboratory from 2012-2013. He was a Research Assistant Professor at the University of Maryland from 2013-2017. Dr. Houim joined the University of Florida in 2017, where he currently serves as an associate professor. He is the recipient of an Air Force Office of Scientific Research Young Investigator Program (YIP) in 2018 and an NSF CAREER award in 2020. His research has focused on a wide range of topics related to the numerical simulation of multiphase reactive flow, including model and numerical algorithm development, with applications to deflagration-to-detonation transition, explosion safety, explosive post-detonation flows, gas-liquid interfacial flows, internal ballistics of gun and rocket systems, and metal particle combustion.