OpenFOAM & Combustion Simulation

blastFoam: Simulation Methods for High Explosives

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Host: Prof. Tai Jin (Zhejiang University)

Register: https://nus-sg.zoom.us/webinar/register/WN_DacHA8OBS5-Ef_Xsq25eXw

Abstract

blastFoam is an opensource library for the simulation of highly compressible flows using explicit methods based on the OpenFOAM library. Included are a suite of flux schemes, thermodynamic models, detonation models, and numerical schemes for accurately and robustly simulating phenomena such as aerodynamic flows, detonation, and shock-particle interactions.

An overview of the governing equations used for simulating high explosive detonations will be presented, along with standard thermodynamic models and both simple and complex models for describing the detonation process. Three cases will be presented: 1) a comparison to idealized air blast correlations, 2) complex detonation models, and 3) a large-scale detonation with complex shock interactions. First, a comparison of blastFoam to the Kingery-Bulmash (K-B) equations will be presented (the K-B equations are internationally recognized as a standard method for quickly estimating loads from detonation events on structures). Next, the validation of a complex detonation model which uses both local pressure and compression to determine reaction rates and wave propagation within the solid energetic materials will be presented. Comparisons are made to the original implementation of the model, as well as experimental data. Finally, a large-scale validation is presented using a 0.46 kg hemispherical PE4 charge obscured by three concrete blocks on a 112 m range. These results are compared to the test data collected from experiments.

About the Speaker

Dr. Jeff Heylmun is the lead developer of the opensource blastFoam computational fluid dynamics solver, developed by Synthetik Applied Technologies where he has worked since 2019. He received his Ph.D. in Mechanical Engineering from Iowa State University in Ames, IA with a focus on quadrature-based moment methods and other standard Eulerian methods for simulating multiphase flows. His works are funded and endorsed by the U.S. Department of Defense for blast load prediction and have a global community of users. He leads interdisciplinary science and engineering software development projects with an emphasis in the fields of detonation, thermodynamics, fluid dynamics, energetic materials, structural materials, and heat transfer. Most recently, Dr. Heylmun has led several U.S. Government funded projects, including modeling and simulation support for the Super Heavy Improvised Explosive Loading Demonstration (SHIELD) Test Program, and the development of modeling and simulation tools for propellant design and optimization for the U.S. Army.