Abstract Submitted
for the SHOCK15 Meeting of
The American Physical Society

Meso-scale simulation of shocked particle laden flows and construction of metamodels[1] OISHIK SEN, Mechanical Engineering, The University of Iowa, SEAN DAVIS, GUSTAAF JACOBS, Aerospace Engineering, San Diego State University, H.S. UDAYKUMAR, Mechanical Engineering, The University of Iowa — In a typical multi-scale modeling problem, such as shock interaction with a dusty gas, information needs to be communicated between disparate length scales, for example between the system scale (order of meters) and the particle scale (order of microns). For the passage of a shock through a cloud of particles, the particle-gas interphase transfer terms in the macro-scale equations are typically based on empirical models of the drag force around a single particle embedded in a shocked flow. Often physical experiments to construct empirical models are restricted in parameter space and difficult or even impossible to perform for a wide range of parameters (Mach number, solid fraction, Reynolds numbers etc.). The goal of the current work is to use high-resolution meso-scale computational experiments as surrogates to physical experiments; a metamodeling approach is developed to "lift" information from the particle scale to the macro-scale. The research compares different metamodeling techniques and demonstrates the efficient use of metamodels to close the macro-scale equations; the meso-scale simulations provide a numerical drag law which can be readily used as a source term in macro-scale governing equations.

[1]We gratefully acknowledge the financial support by the Air Force Office of Scientific Research under grant number FA9550-12-1-0115 and the National Science Foundation under grant number DMS-115631.

Oishik Sen
Mechanical Engineering, The University of Iowa

Date submitted: 28 Jan 2015 Electronic form version 1.4