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Evaluation of Variable-fidelity Techniques for Construction of Surrogates for Drag in Multiscale Modeling for Shock-Particle Interactions OISHIK SEN, KYUNG K CHOI, The University of Iowa, GUSTAAF JACOBS, San Diego State University, UDAYKUMAR H.S., The University of Iowa —
In multiscale modeling of shock-particle interactions, the macroscale is connected to the mesoscale via homogenized closure laws for drag, heat transfer etc. Closure models are obtained using metamodeling techniques; in this work a Modified Bayesian Kriging method (MBKG) is used to estimate statistical measures (such as mean, confidence intervals) of the drag on particles. The drag is computed as a function of Mach number (Ma) and Volume Fraction (ϕ) from high-resolution mesoscale simulations. The process is computationally expensive – each high-fidelity mesoscale simulation is worth several hours of compute time even in multi-processer systems. Therefore, because of the cost of dimensionality, the cost of constructing surrogates becomes prohibitive for higher dimensional parameter spaces. In this work, an alternative route – a variable fidelity technique – is used to construct closures from mesoscale simulations. In this approach, ensembles of low-resolution mesoscale simulations are used to construct an initial surrogate for the mean drag and the confidence intervals as a function of Ma and ϕ. The initial surrogate is then corrected using a few high-fidelity simulations. The overall computational cost for creating surrogates is low because the onus of creating surrogates lies on low-resolution computations. Several variable fidelity techniques will be evaluated for accuracy and savings in compute time for a robust technique for creating surrogates for shock-particle interactions.

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