Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

A Multiscale/Multifidelity CFD Framework for Robust Simulations SEUNGJOON LEE, Brown University, YANNIS KEVREKIDIS, Princeton University, GEORGE KARNIADAKIS, Brown University — We develop a general CFD framework based on multifidelity simulations to target multiscale problems but also resilience in exascale simulations, where faulty processors may lead to gappy simulated fields. We combine approximation theory and domain decomposition together with machine learning techniques, e.g. co-Kriging, to estimate boundary conditions and minimize communications by performing independent parallel runs. To demonstrate this new simulation approach, we consider two benchmark problems. First, we solve the heat equation with different patches of the domain simulated by finite differences at fine resolution or very low resolution but also with Monte Carlo, hence fusing multifidelity and heterogeneous models to obtain the final answer. Second, we simulate the flow in a driven cavity by fusing finite difference solutions with solutions obtained by dissipative particle dynamics – a coarse-grained molecular dynamics method. In addition to its robustness and resilience, the new framework generalizes previous multiscale approaches (e.g. continuum-atomistic) in a unified parallel computational framework.

George Karniadakis
Brown University

Date submitted: 16 Jul 2015

Electronic form version 1.4