Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

**Asynchronous schemes for CFD at extreme scales** ADITYA KONDURI, DIEGO DONZIS, Texas A&M University — Recent advances in computing hardware and software have made simulations an indispensable research tool in understanding fluid flow phenomena in complex conditions at great detail. Due to the nonlinear nature of the governing NS equations, simulations of high Re turbulent flows are computationally very expensive and demand for extreme levels of parallelism. Current large simulations are being done on hundreds of thousands of processing elements (PEs). Benchmarks from these simulations show that communication between PEs take a substantial amount of time, overwhelming the compute time, resulting in substantial waste in compute cycles as PEs remain idle. We investigate a novel approach based on widely used finite-difference schemes in which computations are carried out asynchronously, i.e. synchronization of data among PEs is not enforced and computations proceed regardless of the status of messages. This drastically reduces PE idle time and results in much larger computation rates. We show that while these schemes remain stable, their accuracy is significantly affected. We present new schemes that maintain accuracy under asynchronous conditions and provide a viable path towards exascale computing. Performance of these schemes will be shown for simple models like Burgers' equation.

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Date submitted: 02 Aug 2013 Electronic form version 1.4