Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Asynchronous Direct Numerical Simulations (DNS) of turbulent flows at extreme scales. KOMAL KUMARI, DIEGO DONZIS, Texas A&M University — A major challenge in turbulence simulations is to accurately resolve the wide range of spatio-temporal scales. The computational cost of well resolved DNS grows with Reynolds number steeply and therefore, necessitates the use of massively parallel computations on supercomputers. However, the increase in communication and synchronization cost of current approaches could pose an insurmountable bottleneck at extreme scales. Thus, we have developed a novel paradigm, which relaxes these synchronization requirements at a mathematical level and leads to the so-called Asynchrony-Tolerant (AT) schemes. A first of its kind implementation of these schemes in a 3-D compressible Navier-Stokes DNS solver (forced and decaying) will be presented. Implementation of asynchrony using communication and synchronization avoiding algorithms resulting in periodic and random delays will be discussed. We show that these asynchronous algorithms accurately resolve large and small scale characteristics of turbulence, including instantaneous fields. We also show their efficiency in mitigating the communication bottleneck. The improved scaling, without affecting the physics, makes this asynchronous paradigm a path towards exascale simulations of turbulence and other non-linear phenomena.

Komal Kumari
Texas A&M University

Date submitted: 29 Jul 2019 Electronic form version 1.4