

DOE ASCR Workshop on Turbulent Flow Simulation at the Exascale: Opportunities and Challenges

24---5 August 2015, The Mayflower Hotel, Autograph Collection, Washington, D.C.

Workshop White Papers

The workshop Program Committee is soliciting white papers that address one or more of the workshop's framing questions (listed below). White paper submission is optional, and all invitees are welcome to submit a paper, regardless of whether or not they are able to attend the workshop. White papers will be included in the publicly available workshop documentation and/or on the workshop website. Instructions for white paper preparation and submission are at the bottom of this message.

Workshop Framing Questions:

1. What is the potential impact of exascale simulations of turbulent flow on our fundamental understanding of turbulence?

Most of the recent progress in fundamental understanding of turbulence has come from simulations that push down to the smallest length scales in the flow. In some cases, molecular---level effects have been incorporated. This is an extremely computationally intensive approach. The potential for discovery science in turbulence using increased computing power should be examined in detail.

2. What are the potential impacts on DOE Applied Technology programs (Wind Energy, Nuclear Energy, Stockpile Stewardship)?

While simulations aimed at discovery science in turbulence are generally done using approaches such as Direct Numeric Simulation, engineering simulations in turbulent flows are performed using Large Eddy Simulations and Reynolds Averaged Navier---Stokes simulations. Therefore, the benefits, and potential impacts, of improved simulation capabilities in these areas should be considered separately.

3. What are the potential impacts of exascale simulations that include improved turbulent flow simulations on problems of scientific interest to the Department of Energy?

The potential impacts of increased simulation capability in turbulent flows for climate, fusion, and other DOE Office of Science problems is likely to differ from those of applied programs, and should be considered separately.

4. What are the approaches and challenges to adapting today's software and algorithms for turbulent---flow simulation at the exascale?

The architecture changes created by exascale computing change the relative cost of operations. Memory and chip---to---chip communication capabilities are limited relative to floating point operations. This will create new challenges for implementing turbulent flow solvers that may be particularly relevant in a multi---scale problem such as turbulent flow.

5. What are the opportunities for new software and algorithms for turbulent-flow simulation that may be enabled by exascale capabilities and architectures?

In some areas, the “flops are free” paradigm created by exascale may lead to new computational approaches, and new capabilities. The correct solution approach will not always be a modified version of petascale codes. We propose examining this question for turbulent fluid mechanics.

Instructions for preparing and submitting white papers:

1. White papers must be submitted in PDF format, maximum of 2 pages, inclusive of all figures, tables, references, etc.
2. White papers should be written with 11-point font, preferably Times New Roman, with 1-inch margins on all sides.
3. White papers should be relevant to the workshop’s framing questions (see above).
4. White papers will be accepted through Wednesday, July 29, 2015, and should be submitted to: Deneise.Terry@ornl.gov.