11th. World Congress on Computational Mechanics (WCCM2014)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

The Impact of Emerging Supercomputer Architecture on FSI Algorithms

Rooh A. Khurram

Supercomputing Laboratory
King Abdullah University of Science and Technology (KAUST)
Thuwal, Saudi Arabia
Rooh.Khurram@kaust.edu.sa

The roadmaps of the leading supercomputer manufacturers are based on hybrid systems, which consist of a mix of conventional processors and accelerators. This trend is mainly due to the fact that the power consumption cost of the future cpu-only Exascale systems will be unsustainable, thus accelerators such as graphic processing units (GPUs) and many-integrated-core (MIC) will likely be the integral part of the TOP500 (http://www.top500.org/) supercomputers, beyond 2020. The emerging supercomputer architecture will bring new challenges for the code developers. Continuum mechanics codes will particularly be affected, because the traditional synchronous implicit solvers will probably not scale on Exascale machines. New asynchronous programming paradigms will emerge in the near future. This study is our first attempt to tackle the abovementioned challenges with the help of existing hardware and software tools. First we will report on the parallel performance of our explicit solid mechanics code on GPUs and MIC. We will also show FSI results for flow over airfoil using our new code. In another study, we apply our mesh motion algorithm [1,2] for performing r-refinement/mesh adaptation for unstructured meshes. We will demonstrate that the cost of solving mesh motion algorithm is less than the cost of performing re-partitioning of the mesh on modern hybrid supercomputers.

References

1. M. Fossati, R.A.Khurram, W. G. Habashi, An arbitrary Lagrangian-Eulerian mesh movement scheme for long-term in-flight ice accretion, International Journal of Numerical Methods in Fluids, 68(8), 958–976, 2012
2. Arif Masud, Manish Bhanabhagvanwala, Rooh A. Khurram, An adaptive mesh rezoning scheme for moving boundary flows and fluid–structure interaction, Computers & Fluids (36), 77–91, 2007