Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

A massively parallel unstructured overset method for large-scale simulation of moving bodies in turbulent flows[1] WYATT HORNE, KRISHNAN MAHESH, University of Minnesota — We present an unstructured overset method capable of performing direct numerical simulation (DNS) and large eddy simulation (LES) of many ($O(10^5)$) moving bodies, utilizing many computational cores ($O(10^5)$) as shown in Horne & Mahesh [J. Comput. Phys.(2019) *In Press*]. A dynamic overset assembly is conducted to connect mesh solutions. To establish communication patterns a parallel master/slave algorithm is used. A parallel flood-fill algorithm is used for cutting. For searches, k-d tree data structures are used. Often the connectivity between overset meshes remains the same between time steps. The temporal coherence of objects is directly used to only update necessary information with time, resulting in substantial cost savings. A non-dissipative finite volume method is used for the fluid flow. An interpolant is used which has superior kinetic energy properties compared to local reconstructions. To solve pressure, a penalty constraint formulation is used, resulting in a symmetric, positive definite system. Strong scaling is demonstrated for 100,000 particles in a turbulent channel flow up to 492,000 cores. Detailed flow results illustrating the method are presented.

[1]Supported by DOE

Wyatt Horne
University of Minnesota

Date submitted: 30 Jul 2019 Electronic form version 1.4