Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

An optimal sparse sensing approach for adaptive mesh refinement in unsteady flows[1] DANIEL FOTI, University of Memphis, SVEN GIORNO, KARTHIK DURAISAMY, University of Michigan — Complex physical flows are often characterized by coherent structures, which have a crucial role in turbulent flows. In order to accurately simulate the flow field, the coherent structures need to be adequately resolved with a sufficiently fine mesh. Furthermore, local mesh refinement in areas of interest can be employed to reduce time while preserving accuracy. While mesh adaptation techniques are well-established for steady flows, refinement methodology for unsteady, spatially-evolving flows is less straightforward. Residual and error-minimization based methods require precise definitions for spatio-temporal error, and feature or gradient based methods rely overtly on user intuition of the flow, while adjoint-based methods can become expensive for finite volume methods. We introduce a novel approach for adaptive mesh refinement where selection is obtained similar to a computationally expedient discrete empirical interpolation method using rank-revealing QR. This method seeks optimal locations for grid adaptation from the basis of a proper orthogonal decomposition, which organizes velocity flow field features into optimal orthogonal modes based on energy. The methodology is tested on a series of cases including shock formation and flows dominated by coherent structures.

[1]This work is supported through a subcontract from Continuum Dynamics, Inc. under Navy STTR Phase II contract N68335-17-C-0158

Daniel Foti
University of Memphis

Date submitted: 31 Jul 2019 Electronic form version 1.4