Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Application of a derivative-free global optimization algorithm to the derivation of a new time integration scheme for the simulation of incompressible turbulence. SHAHROUZ ALIMOHAMMADI, DANIELE CAVAGLIERI, POORIYA BEYHAGHI, THOMAS R. BEWLEY, University of California San Diego — This work applies a recently developed Derivative-free optimization algorithm to derive a new mixed implicit-explicit (IMEX) time integration scheme for Computational Fluid Dynamics (CFD) simulations. This algorithm allows imposing a specified order of accuracy for the time integration and other important stability properties in the form of nonlinear constraints within the optimization problem. In this procedure, the coefficients of the IMEX scheme should satisfy a set of constraints simultaneously. Therefore, the optimization process, at each iteration, estimates the location of the optimal coefficients using a set of global surrogates, for both the objective and constraint functions, as well as a model of the uncertainty function of these surrogates based on the concept of Delaunay triangulation. This procedure has been proven to converge to the global minimum of the constrained optimization problem provided the constraints and objective functions are twice differentiable. As a result, a new third-order, low-storage IMEX Runge-Kutta time integration scheme is obtained with remarkably fast convergence. Numerical tests are then performed leveraging the turbulent channel flow simulations to validate the theoretical order of accuracy and stability properties of the new scheme.

Shahrouz Alimohammadi
Univ of California - San Diego

Date submitted: 04 Aug 2016 Electronic form version 1.4