Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Performance investigation of multigrid optimization for DNS-based optimal control problems[1] CORNELIA NITA, KU Leuven, Mechanical Engineering, STEFAN VANDEWALLE, KU Leuven, Computer Science, JOHAN MEYERS, KU Leuven, Mechanical Engineering, Celestijnenlaan 300A, B3001 Leuven, Belgium — Optimal control theory in Direct Numerical Simulation (DNS) or Large-Eddy Simulation (LES) of turbulent flow involves large computational cost and memory overhead for the optimization of the controls. In this context, the minimization of the cost functional is typically achieved by employing gradient-based iterative methods such as quasi-Newton, truncated Newton or non-linear conjugate gradient. In the current work, we investigate the multigrid optimization strategy (MGOpt) in order to speed up the convergence of the damped L-BFGS algorithm for DNS-based optimal control problems. The method consists in a hierarchy of optimization problems defined on different representation levels aiming to reduce the computational resources associated with the cost functional improvement on the finest level. We examine the MGOpt efficiency for the optimization of an internal volume force distribution with the goal of reducing the turbulent kinetic energy or increasing the energy extraction in a turbulent wall-bounded flow; problems that are respectively related to drag reduction in boundary layers, or energy extraction in large wind farms. Results indicate that in some cases the multigrid optimization method requires up to a factor two less DNS and adjoint DNS than single-grid damped L-BFGS.

[1]The authors acknowledge support from OPTEC (OPTimization in Engineering Center of Excellence, KU Leuven, grant no PFV/10/002).

Johan Meyers
KU Leuven, Mechanical Engineering, Celestijnenlaan 300A, B3001 Leuven, Belgium

Date submitted: 01 Aug 2016 Electronic form version 1.4