Optimal Active Flow Control Using Discrete Adjoints

A. Nemili[1], E. Özkaya[2], N. R. Gauger[3], A. Carnarius[4], and F. Thiele[5]

Abstract: We present the development of a discrete adjoint approach for the optimal control of viscous flows, governed by unsteady incompressible Reynolds Averaged Navier Stokes equations. The adjoint solver is developed by applying automatic differentiation (AD) techniques in reverse mode. The unsteady adjoints usually require the storage of the complete flow history during the forward-in-time integration of the primal equations, which is then used while solving the adjoint equations in backward-in-time integration. For large scale applications, the memory requirements for storing the flow solutions can become prohibitively expensive. To reduce the excessive memory demands, the binomial checkpointing strategy has been employed. Numerical results are presented for the test cases of optimal active flow control around a rotating cylinder and a NACA4412 airfoil.

[1,2,3] Department of Mathematics and Center for Computational Engineering Science (CCES)
RWTH Aachen University
Schinkelstr. 2, 52062 Aachen, Germany
{*nemili, ozkaya, gauger*}*@mathcces.rwth-aachen.de*

[4,5] Institut für Strömungmechanik und Technische Akustik - ISTA
Technische Universität Berlin
Müller-Breslau-Str. 8, 10623 Berlin, Germany
{*angelo.carnariuse, frank.thiele*}*@cfd.tu-berlin.de*