11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

UNSTEADY CONTINUOUS ADJOINT METHOD USING POD FOR JET-BASED FLOW CONTROL

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Key words: *Unsteady continuous adjoint, Proper Orthogonal Decomposition, Incremental Singular Value Decomposition, Flow Control, Optimization.*

In the present paper a flow control optimization, based on pulsating jets, is performed using the unsteady continuous adjoint method. The jets are placed in a fixed predetermined position, whereas the jets' operating characteristics are controlled for drag reduction. The adjoint method, in its continuous variant, is used to compute the derivatives of the objective function with respect to the control variables.

When the adjoint method is applied to unsteady flow problems, the standard compromise between computational cost and memory storage requirements is the so-called binomial check-pointing technique. For a given number of time instants, the check-pointing technique determines the optimal distribution of flow field solution snapshots in time which ensures minimal recomputations of the flow (primal) solutions. Despite the reduced storage requirement of the check-pointing technique, the extra computational cost, due to the necessary recomputations, may prove to be non-affordable for large scale problems.

This paper makes use of alternative techniques to check-pointing in order to handle unsteady flows, based on the approximation of the time-evolution of flow fields, so as to entirely overcome recomputations.

Proper Orthogonal Decomposition (POD) method is used. An incremental POD method, which utilizes a fixed maximum rank for the orthonormal basis, is presented. The presented method is compared to reference solutions obtained using check-pointing, in terms of both accuracy and overall simulation time.

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