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THE FRENCH AEROSPACE LAB

PROPOSITION DE SUJET DE THESE

Intitulé : Analysis and implementation of a goal-oriented mesh refinement method for (RANS) flows

Référence : **SNA-DAAA-2021-24**
(à rappeler dans toute correspondance)

Début de la thèse : March/October 2022	**Date limite de candidature :** 01/06/2022

Mots clés
Refinement, Goal-oriented adaptation, Mesh, Error estimator, RANS

Profil et compétences recherchées

Master of Science or French "Grande Ecole"

Aeronautical Engineering, Applied Maths, Fluid Dynamics

Présentation du projet doctoral, contexte et objectif

Several so-called "goal-oriented" mesh adaptation methods have been developed since 2001 to obtain the value of a function of interest (like lift, drag, pitching moment…) with the desired accuracy, after a few specific remeshing and flow calculation steps. ONERA and NIA have proposed methods based on the total derivative of the output of interest with respect to volume mesh nodes, dJ/dX, that is computable after solving the discrete adjoint equation. Recent improvements of the discrete adjoint capability at ONERA now allow the complete extension of ONERA's method [1,2] to (RANS) flows.

First, the influence of the mesh regularity on the scheme accuracy will be studied, inside and outside of the boundary layer. Second, a scalar criterion based on dJ/dX will be defined, analyzed and tested for the usual (RANS) mesh adaptation problems (fixed wall mesh, fixed number of planes in the boundary-layer, fixed boundary layer mesh). The convergence rate of the usual functions of interest is also to be analyzed.

In a further step, a multidimensional criterion (typically a metrics matrix) is to be defined either by multidimensional processing of previous criterion or by the extraction of a richer information (than a scalar field at the nodes) from the dJ/dX vector field. The corresponding refinement process will then be demonstrated and analyzed for cases (typically involving shock wave propagation) where anisotropic refinement is fruitful. The convergence rate of the functions of interest is to be studied.

[1] J. Peter et al. Computers and Fluids 2012 [2] Todarello et al. J. of Computational Physics 2016

Collaborations envisagées

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