THESE

Wavelet-based multiscale simulation of incompressible flows

Brijesh PINTO

Abstract

This thesis focuses on the development of an accurate and efficient method for performing Large-Eddy Simulation (LES) of turbulent flows. An LES approach based upon the Variational Multiscale (VMS) method is considered. VMS produces an a priori scale-separation of the governing equations, in a manner which makes no assumptions on the boundary conditions and mesh uniformity. In order to ensure that scale-separation in wavenumber is achieved, we have chosen to make use of the Second Generation Wavelets (SGW), a polynomial basis which exhibits optimal space-frequency localisation properties. Once scale-separation has been achieved, the action of the subgrid model is restricted to the wavenumber band closest to the cutoff. We call this approach wavelet-based VMS-LES (WAV-VMS-LES). This approach has been incorporated within the framework of a high-order incompressible flow solver based upon pressure-stabilised discontinuous Galerkin FEM (DG-FEM). The method has been assessed by performing highly under-resolved LES upon the 3D Taylor-Green Vortex test case at two different Reynolds numbers.

Keywords: discontinuous Galerkin method; second generation wavelets; variational multiscale method; large-eddy simulation.

Jeudi 29 juin 2017, à 14h00
Salle Contensou à l'ONERA Châtillon

Composition du jury

M. Michel Deville,	Professeur à l'EPFL-Lausanne,	Rapporteur
M. Kai Schneider,	Professeur à Aix-Marseille Université,	Rapporteur
M. Esteban Ferrer,	Lecturer à l'Université Polytechnique de Madrid,	Examinateur
M. Guido Lodato,	Maître de conférences à l'INSA de Rouen,	Examinateur
M. Michel Visonneau,	Directeur de recherche au CNRS-Centrale Nantes,	Examinateur
Mme. Marta de la Llave Plata,	Chercheur-ingénieur à l'ONERA-Châtillon,	Examinateur
M. Eric Lamballais,	Professeur à l'Université de Poitiers,	Examinateur

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