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ADVANCES IN THE PSEUDO-DNS METHODOLOGY: DATABASE CONSTRUCTION FOR THE AVERAGED INERTIAL STRESSES ON THE INTERNAL RVE

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Abstract. Pseudo Direct Numerical Simulation (pseudo-DNS) is a novel concurrent multiscale methodology which splits the numerical solution into two: the coarse and the fine parts. Here, the coarse scale solution is computed as usual using a relatively coarse mesh but including the pre-computed inertial stresses from the fine-scale solution. To introduce the basis of the method, in this work the pseudo-DNS model is first applied to the classical convection-diffusion problem. Secondly, in the context of Navier-Stokes solutions far from walls, a database for the fine-scale response is constructed. Several DNS simulations varying the dimensionless tensor Id, which can be reduced to two parameters, are carried out on a Representative Volume Element (internal RVE) to obtain the averaged internal stresses. Numerical results reveal that some critic Id magnitude, named Id_c, can be found. The latter allows distinguishing two kinds of fine-scale solutions: steady state or chaotic transient solutions, i.e. with or without instabilities in the fluid. Therefore, a global stability analysis solving generalized eigenvalue problems is also presented in this work to validate the existence and the value of such Id_c. Finally, the database is modeled through an artificial neural network to favor its computational implementation.

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