TEMPUS "COFFEE" Project

http://ec.europa.eu/education/programmes/tempus/index_en.html

Numerical studies with *Code_Saturne* at the University of Oran, Algeria

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2007 meeting of *Code_Saturne* users, EDF R&D Chatou France 26-27 Nov 2007

COFFEE PROJECT:
http://cfd.mace.manchester.ac.uk/coffee
https://umepc059.me.umist.ac.uk/UstoOran/.

Introduction

COFFEE is an EU funded joint project between University of Manchester, EDF R&D Chatou and Université des Sciences et Technologie d'Oran. The principal objectives is to provide training in **C**omputation **F**or **F**luid and **E**nergy **E**ngineering to Algerian engineers and researchers. More specifically:

1. (PG) Opening of a post-graduation COFFEE course at USTO, Algeria.
2. (PD) Opening of a specialised professional development course for technical industrial staff.
3. Opening of a CFD centre with quality hardware (80 CPU linux cluster) and software (*Code_Saturne* !), support and academic staff.
4. Elaboration of the graduate course programme for COFEE.
5. Opening of a graduation course COFFEE at USTO, Algeria.

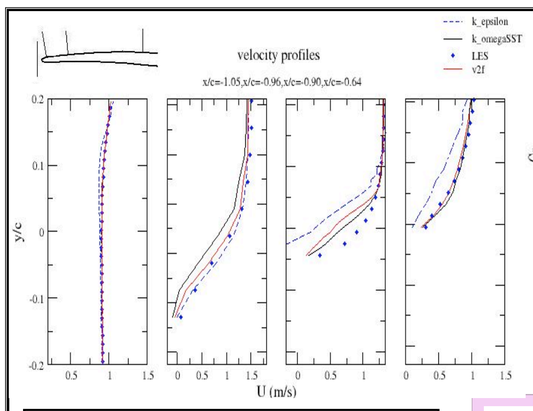


Figure-2 Streamwise velocity profiles. Comparison of Different RANS models with the LES predictions.

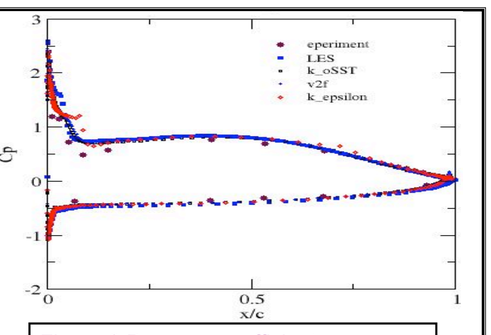


Figure-3 Pressure coefficient distribution along the airfoil surface.

Figure-1 The geometry of the airfoil considered in the present study.

Numerical study of Valeo airfoil

- N. Akermi [1] carried out a numerical study of a fan blade and compared predictions of different low-Re models.
- In general, all the models were found to return a reasonably good predictions for the pressure coefficient distribution. The differences observed are mainly at the leading edge (a too large laminar separation is predicted by k-epsilon).
- The v^2-f results are in superior agreement with the Experiment and the LES data.

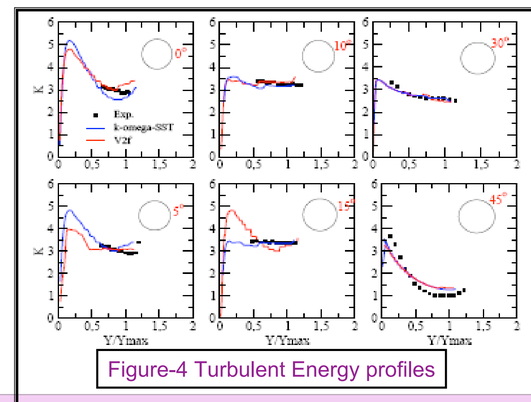


Figure-4 Turbulent Energy profiles

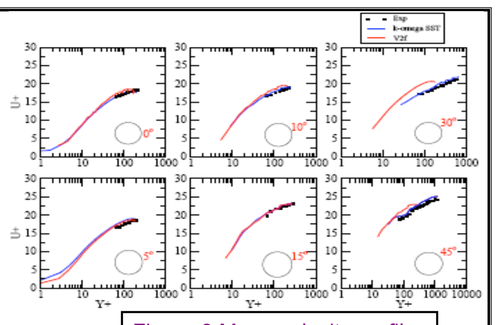
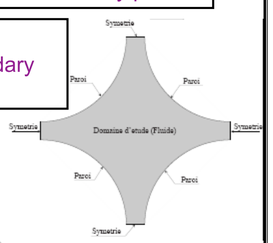


Figure-3 Mean velocity profiles

Figure-1 Physical Domain and boundary conditions



Flow parallel to tube Bundles

- A numerical study of flow parallel to tube bundles using the Low-Re k-ω SST, and v^2-f models have been conducted by the MSc student Merzoug with *Code_Saturne* [3].
- At the centre of the domain the predictions of both models are observed to agree well with experimental data
- Some differences between the models are found in the near-wall region (see fig. 4), but no experimental data is available here. We plan to run a refined LES to provide this near-wall information.

Figure-2 The grid used for the numerical tests

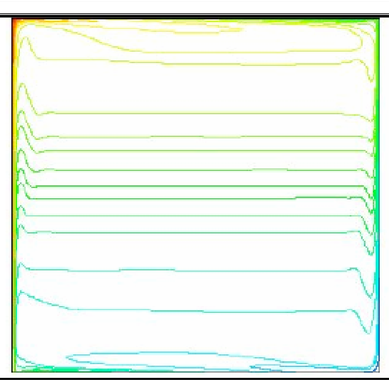
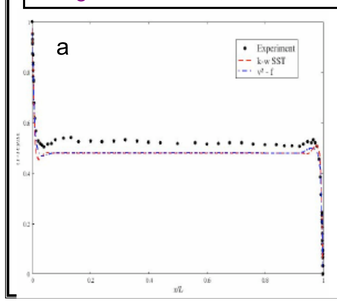


Figure-1 iso-lines of temperature inside the square cavity.

Natural convection in a square cavity

- A numerical study of a turbulent natural convection in a square cavity using the Low-Re k-ω SST, and v^2-f models has been conducted by the MSc student Belharizi with *Code_Saturne* [2].
- The v^2-f model is found to be able to mimic better the patterns of the flow in the present test case.
- Both models under-predict the turbulent energy levels, but the v^2-f predictions are somewhat better.

Figure-2 Temperature profiles, a) along a horizontal line, b) along a vertical line, at the centre of the domain.



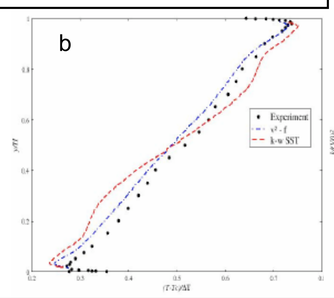
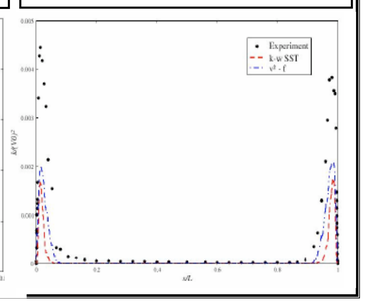


Figure-3 Profiles of turbulent energy along a horizontal line at the centre of the domain.



Validation du Code Saturne; Cas du jet 2D axisymétrique impactant une paroi

H. Merine Sassi:
La valeur calculée du Nusselt, coefficient d'echange entre le fluide et la paroi, est comparée avec des mesures expérimentales, qui comportent, en outre, des mesures détaillées des vitesses et des grandeurs turbulentes, pres de la paroi. Avec lois de paroi les résultats sont assez sensibles au maillage, alors qu'avec un modèle bas Reynolds cette sensibilité disparait.

Figure-1 Description de la configuration et conditions au limites

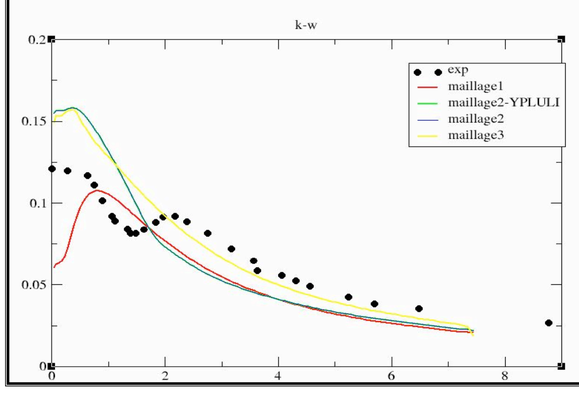
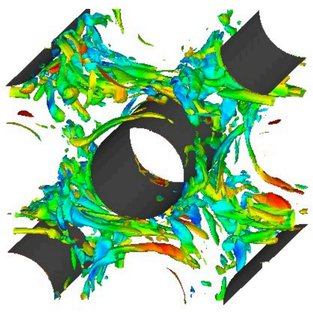
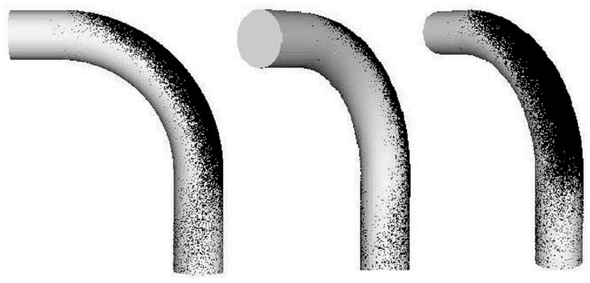


Figure-2 Influence du maillage utilisé sur la distribution du Nusselt local sur la paroi.

Other studies (see posters)



Flow across tube Bundles



Aerosol deposition in 90° bend

References:

[1] N. Akermi, 2007 "Toward RAN/LES coupling; Valeo Airfoil test case", *MSc Dissertation, Marine Engineering Department, U.S.T.ORAN Univerisity, Oran, Algeria*.
[2] M. Belharizi, 2007 "Performance des models à bas nombre de Reynolds dans la prédiction des écoulements thermoconvectifs", *Marine Engineering Department, MSc Dissertation, U.S.T.ORAN Univerisity, Oran, Algeria*.
[3] A. Merzoug, 2007 "A study of flow parallel to tube bundles using different RANS models", *Marine Engineering Department, MSc Dissertation, U.S.T.ORAN Univerisity, Oran, Algeria*.

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