
Contract No.:
GTC1-CT99-10030

**A THEMATIC NETWORK FOR QUALITY AND TRUST
IN THE INDUSTRIAL APPLICATION OF CFD**

October 8, 2001

Document Code:
TA1 D29

Quality Review RAE M2155 Wing

CFS

QNET-CFD

*A Thematic Network for Quality and Trust
in the Industrial Application of
Computational Fluid Dynamics*

TA1 D29

QUALITY REVIEW RAE M2155 WING

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INSTRUCTIONS TO THE REVIEWER

Please indicate your agreement or disagreement with the comments below, by ticking either the YES or NO box (using symbol). If you would like to comment on any of the questions, please also tick the CO (comment) box, and add your comments in the box provided at the end of each section. Please make sure that all questions are answered.

You are also asked to assess the impact of certain uncertainties on DOAPs (High, Moderate or Low). An impact is judged low if it is only a second order effect, moderate if it is significant but there is a known way of managing its effects, and high otherwise.

Finally, please identify Underlying Flow Regimes for this AC in the space provided (a provisional list of UFRs has been issued by the Scientific Coordinator).

Application Challenge (AC) Title: RAE M2155 Wing

AC Author and Thematic Area: P. Catalano (CIRA) and A. Hutton (DERA), TA1

Reviewer (Name/Organisation) : J.B. Vos/CFS Engineering

1	TOP LEVEL CHECK	YES	NO	CO
1	Is this AC an Industrial test case for judging CFD competency?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	Are the design/assessment parameters (DOAPs) defined?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
1	Have these assessment parameters been measured?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	Are CFD calculations available ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	Importance of AC to Industrial Sector (IS)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		H	M	L

Comments:

Only the aerodynamic coefficients are mentioned as DOAP's, which can be considered as somewhat limited, in particular for turbulent flows

Please identify Underlying Flow Regimes for this AC:

- 3.1 Reattaching shear layers/pressure recovery
- 3.1 Shock-boundary layer interaction
- 3.1 Boundary layer under adverse pressure gradient causing separation
- 3.2 3D Skewed boundary layer
- 3.4 Wing – body (ground plate) junction

DETAILED CHECK

2	GEOMETRY	YES	NO	CO
2. 1	Is the geometry fully specified?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2. 2	Are the locations of boundaries specified?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. 3	Are the boundary types specified?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. 4	Is the geometry clearly illustrated?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. 5	Is the geometry available in digital form?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

The geometry is available as an ASCII file in the format of 33 sections of 145 points each. Transition is fixed at 5% local chord, and a geometric definition of this line is available.

3	FLOW PHYSICS AND FLUID DYNAMICS DATA	YES	NO	CO
3. 1	Are the physics of key processes identified?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. 2	Are the properties of the fluid specified?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. 3	Are the governing non-dimensional parameters (GNPDS) identified?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

TEST DATA

4	OVERVIEW OF TEST DATA	YES	NO	CO
4. 1	Have all the experiments been adequately defined?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. 2	Are the measurement techniques used described?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. 3	Has a summary of test runs been provided (matrix)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. 4	Are there any important scaling issues/simplifications/uncertainties associated with the test geometry?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4. 5	Impact of uncertainties on DOAPs ?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		H	M	L
Comments:				

5	EXP1 (<i>Copy and complete this section for each set of test data</i>)	YES	NO	CO
5. 1	Is the experimental setup defined unambiguously?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. 2	Are the geometrical parameters defined?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. 3	Are the values of GNDPs specified?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. 4	Are the measured parameters (MPs) fully described?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. 5	Are measured data available in digital format?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. 6	Have conditions at all boundaries been specified?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. 7	Are any of the boundary data uncertain?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5. 8	Is a realistic estimate of data accuracy given?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. 9	Impact of uncertainties on DOAPs ?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		H	M	L
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CFD SIMULATIONS

6	OVERVIEW OF CFD SIMULATIONS	YES	NO	CO
6.1	Have all the CFD runs been adequately defined?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.2	Are the solution techniques used described?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.3	Has a summary of runs been provided (matrix)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6.4	Are there any important uncertainties associated with the computational domain geometry?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
		H	M	L
6.5	Impact of uncertainties on DOAPs ?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Comments: The provided test matrix does not follow the standard lay out.				

7	CFD1 (<i>Copy and complete this section for each set of CFD data</i>)	YES	NO	CO
7.1	Is the modelling strategy defined?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.2	Is the modelling strategy appropriate for the physical problem?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Solution strategy			
7.3	Is the code (and version) specified?	<input checked="" type="checkbox"/>		
7.4	Are the equations solved described adequately?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.5	Is the numerical discretisation scheme used specified?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7.6	Is the solution algorithm described?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Computational Domain			
7.7	Is the domain fully described?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.8	Boundary conditions fully detailed?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.	Is the domain used an	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

7. 1 0	idealisation/simplification? Is the mesh used fully described?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7. 1 1	Is the mesh quality appropriate?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7. 1 2	Boundary Conditions Are the boundary conditions fully defined?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7. 1 3	Are they appropriate?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 1 4	Do these replicate conditions in test rig?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 1 5	Were sensitivity runs carried out to explore effects of uncertainties in boundary data?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7. 1 6	Application of physical models Were turbulence models and other physical models applied in an appropriate and consistent way?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 1 7	Numerical Accuracy Is there any demonstration/estimation of numerical (discretisation) accuracy?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7. 1 8	Was a mesh sensitivity study carried out?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 1 9	Was sufficient iteration convergence achieved?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 2 0	Impact of uncertainties on DOAPs ?	H <input type="checkbox"/>	M <input type="checkbox"/>	L <input type="checkbox"/>

Comments:

It was indicated that one of the meshes used had the inflow boundary too far from the model, resulting in poor results.

No information on the free stream values of the turbulent variables is given.

No information is available on the numerical dissipation used.

7	CFD2 (<i>Copy and complete this section for each set of CFD data</i>)	YES	NO	CO
7. 2 1	Is the modelling strategy defined?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 2 2	Is the modelling strategy appropriate for the physical problem?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 2 3	Solution strategy Is the code (and version) specified?	<input checked="" type="checkbox"/>		
7. 2 4	Are the equations solved described adequately?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 2 5	Is the numerical discretisation scheme used specified?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 2 6	Is the solution algorithm described?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 2 7	Computational Domain Is the domain fully described?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 2 8	Boundary conditions fully detailed?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 2 9	Is the domain used an idealisation/simplification?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7. 3 0	Is the mesh used fully described?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 3 1	Is the mesh quality appropriate?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 3 2	Boundary Conditions Are the boundary conditions fully defined?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 3 3	Are they appropriate?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. 3 4	Do these replicate conditions in test rig?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 3 5	Were sensitivity runs carried out to explore effects of uncertainties in boundary data?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Application of physical models				
7. 3 6	Were turbulence models and other physical models applied in an appropriate and consistent way?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Numerical Accuracy				
7. 3 7	Is there any demonstration/estimation of numerical (discretisation) accuracy?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7. 3 8	Was a mesh sensitivity study carried out?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 3 9	Was sufficient iteration convergence achieved?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. 4 0	Impact of uncertainties on DOAPs ?	H <input type="checkbox"/>	M <input type="checkbox"/>	L <input checked="" type="checkbox"/>

Comments:

The influence of the mesh was studied, and had a considerable impact on the Cd. No full grid convergence was demonstrated for this parameter (the CL was grid converged).

8	EVALUATION - Comparison of Test data and CFD	YES	NO	CO
8. 1	Is the comparison of CFD and test data clearly presented?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
8. 2	Are the discussion, conclusions and recommendations adequately supported by the available experimental and CFD results?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

CFD DOAP results are given in the CFD Section and experimental values in Test Data Section

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, but no direct comparison between CFD and experimental results is given.