

The 49th Fluid Dynamics Conference/ The 35th Aerospace Numerical Simulation Symposium
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Test cases of Third Aerodynamics Prediction Challenge (APC-III)

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APC committee

Issues of APC-I and APC-II

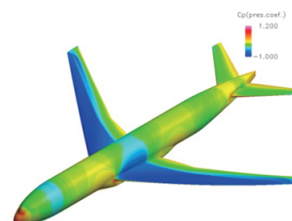


- The variation of CFD is large for high angles of attack
 - **Test case 1:** Investigation of grids and turbulence models for high angle-of-attack flows
 - The committee recommends turbulence models other than SA
- The slight difference remains between CFD and experiment
 - **Test case 2:** Discussion on the difference based on follow-up computations under arbitrary conditions
- Improvement of buffet prediction accuracy
 - **Test case 3:** Comparison with unsteady pressure frequency spectra, unsteady PSP
 - Unsteady pressure data and flow field data are submitted.

Test Case 1: Alpha-sweep



- Model: NASA-CRM($i_H=0\text{deg}$) without support device
- Grid: Medium($\sim 10\text{M}$)
- Conditions: $M = 0.847$, $Re_c = 2.26 \times 10^6$, $T_{ref} = 284\text{K}$
- Angles: -1.79deg , -0.62deg , 0.32deg , 1.39deg , 2.47deg , 2.94deg , 3.55deg , 4.65deg , 5.72deg
- Data to be submitted:
 - Aerodynamic coefficients(C_D, C_L, C_m)
 - Decompose them into pressure and friction
 - Decompose them into parts (main wing, fuselage, tail)
 - Surface C_p distributions
 - Main wing
- Recommendations:
 - Usage of turbulence models other than SA
 - Discussion on high-angle-of-attack flows



3

Test case 2: Follow-up discussion



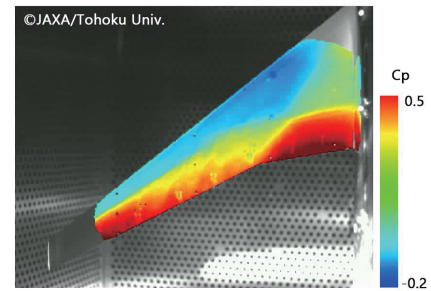
- Model: NASA-CRM (arbitrary configurations)
- Grid: arbitrary grids
- Conditions: arbitrary conditions
- Angles: arbitrary angles
- Data to be submitted: None
- Recommendations:
 - Discussion on the difference observed in APC-I and APC-II
 - Aeroelasticity
 - Wall interference
 - Transition
 - No tails
 - High Re
 - Subsonic

4

Test case 3: Buffet



- Model: NASA-CRM($i_H=0\text{deg}$) with deformation
- Grid: Arbitrary grids
- Conditions: $M = 0.85$, $Re_c = 1.5 \times 10^6$, $T_{ref} = 282\text{K}$
- Angles: 4.87deg , 5.92deg
- Data to be submitted:
 - Aerodynamic coefficients(C_D, C_L, C_m)
 - Surface C_p distributions
 - Average, RMS
 - Frequency spectra
 - Flow field contours
 - (Pressure, Mach number, eddy viscosity)



Unsteady PSP (6deg)
Sugioka, et al., ICAS2016

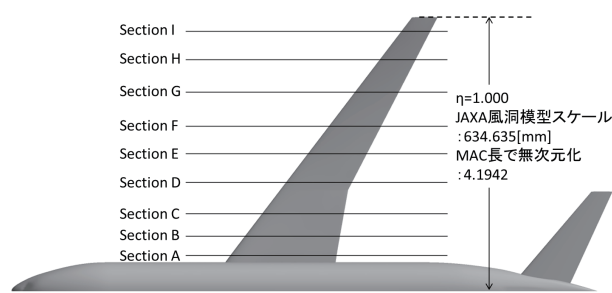
5

Cp measurement



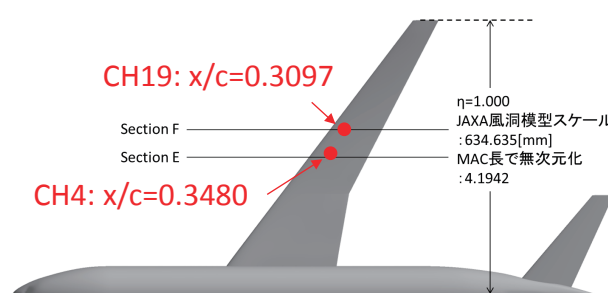
Steady

Sections A-I



Unsteady

Sections E, F

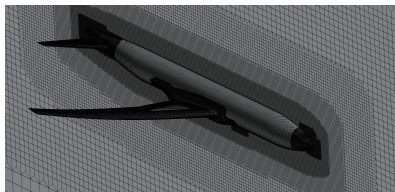


6

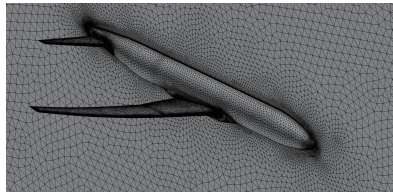
APC Website



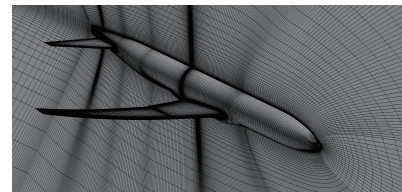
- NASA-CRM geometry (STL, IGES)
 - Original and deformed shapes are available
- Grid (HexaGrid, MEGG3D, UPACS)
 - Original and deformed shapes are available
- Wind tunnel data (steady/unsteady)
 - Force, moment, Cp, oil-flow
- Please see the APC website for more information
 - <https://cfdws.chofu.jaxa.jp/apc/>



HexaGrid
(Hexa, Unstructured)



MEGG3D
(Tetra, Unstructured)



UPACS
(Hexa, Structured)