Systematic improvement of build and comparison of aerodynamic models of aircraft (Indirect Reynolds number effect evaluation)

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Abstract

In aircraft development, aerodynamic characteristics of an aircraft are generally estimated using wind tunnels which can achieve insufficient Reynolds number. In this research, based on former research results, numerical analysis of transonic flow phenomena around an transport aircraft concerning indirect effect due to Reynolds number variation which can not be corrected using classical methods is performed.

Reasons for using JSS2

To evaluate flow phenomena around transonic transport aircraft due to Reynolds number variation by computational fluid dynamics.

Achievements of the Year

To reproduce significant indirect Reynolds number effect which appeared in the C-141 transport aircraft development, computational fluid dynamics analysis around whole aircraft was performed. In the performed analysis, indirect Reynolds number effect was, however, not observed in the case at wind tunnel Reynolds number, while the pressure distribution around the aircraft main wing agreed well with the flight test results at Re = 50e6. In the case with replacement of airfoil to a symmetric one to emphasize shock waves, indirect effect as significant shock relocation was observed. By flow visualization, cause of the shock relocation was confirmed due to span-wise flow-in inside the shock induced separtion. Downsizing of the flow-in vortex along Reynolds number variation brought the sudden shock relocation.

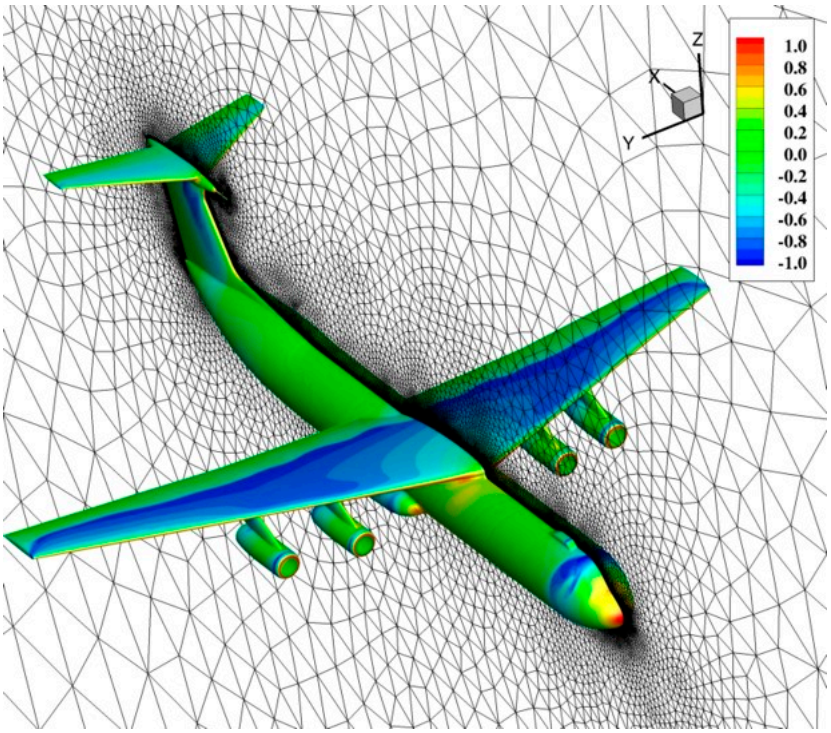

Fig. 1: Schematic drawing of the C-141 model

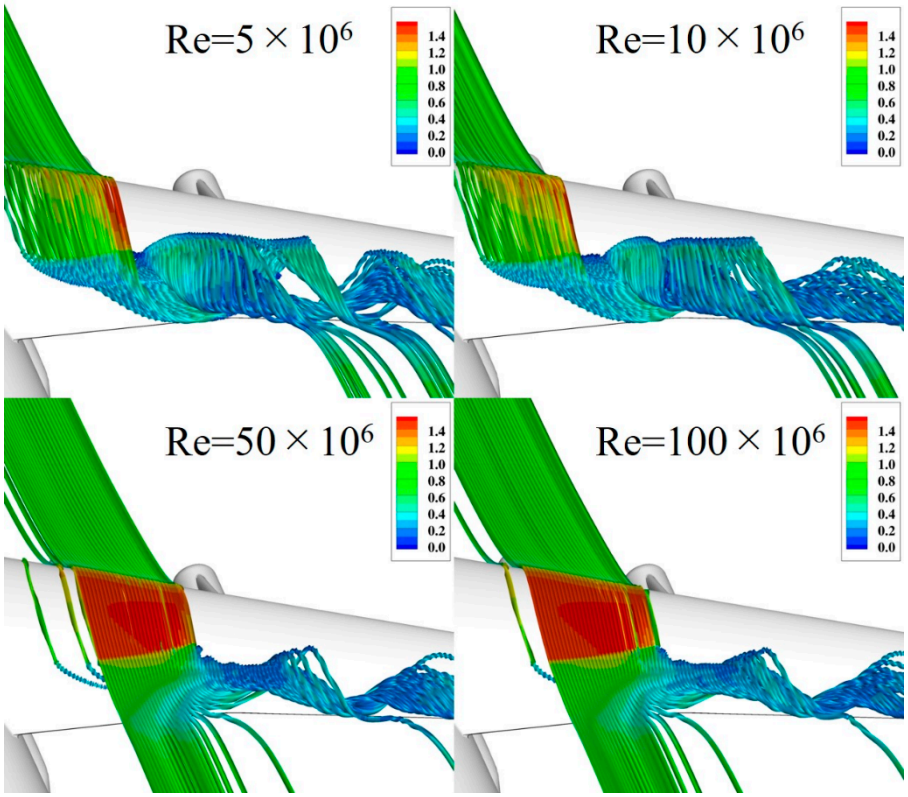

Fig. 2: Flow pattern around the main wing employing symmetric airfoils.

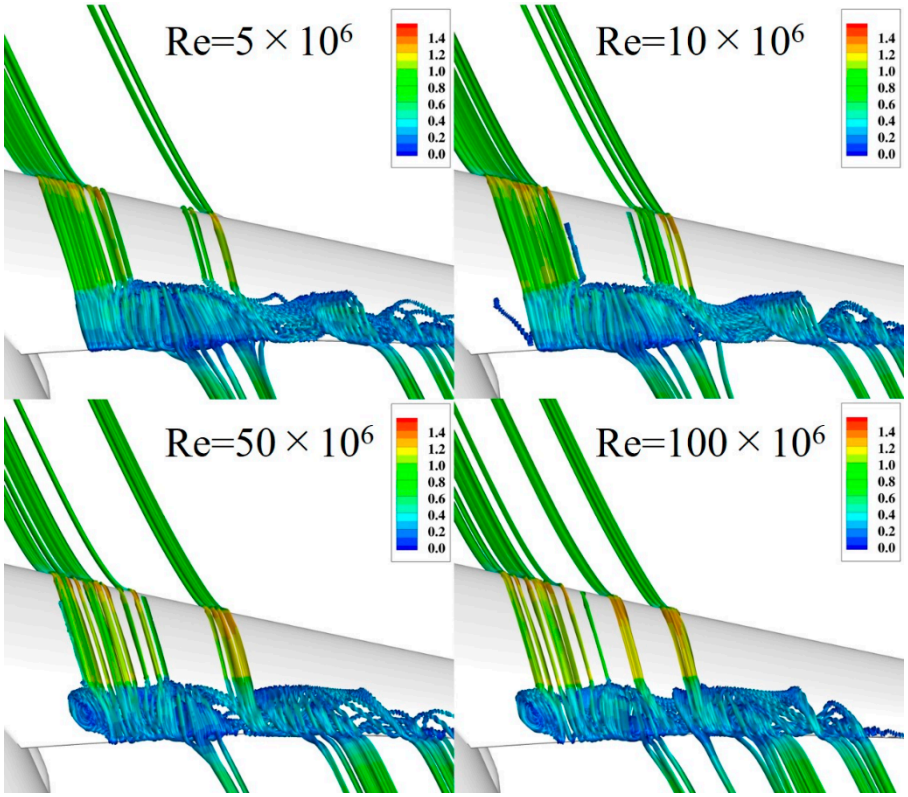

Fig. 3: Flow pattern around the main wing employing C-141's airfoils.

Publications

N/A

Usage of JSS2

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	216
Elapsed Time per Case	9.9 Hour (s)

Resources Used

Fraction of Usage in Total Resources[*1] (%): 0.18

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2] (%)
SORA-MA	1,667,274.24	0.20
SORA-PP	0.00	0.00
SORA-LM	0.00	0.00
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2 (%)
/home	9.54	0.01
/data	95.37	0.00
/ltmp	1,953.13	0.17

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	0.00	0.00

[*1]: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

[*2]: Fraction of Usage: Percentage of usage relative to each resource used in one year.