Investigation of Aerodynamic Performances at Low Reynolds Number Condition with Mach Number Effect

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Abstract

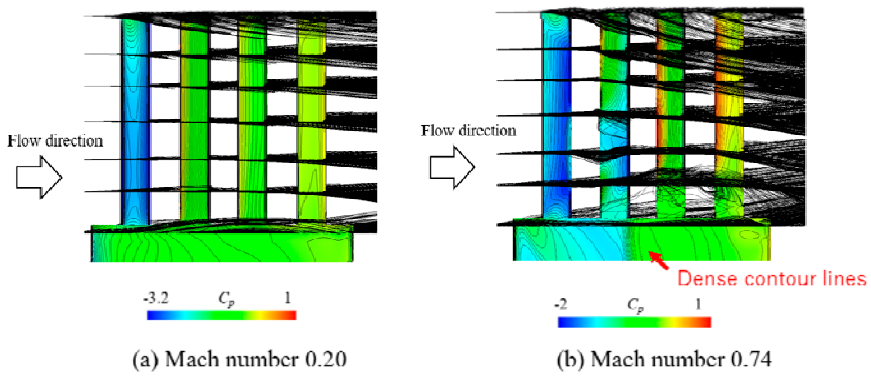
Birds such as hawks have excellent characteristics of flight efficiency and quiteness. One of these distingusished features is thought to be the shape of wingtip with multiple wings and gaps. The purpose of this project is to clarify these mechanisims of wingtip and to obtain knowledge of wing_grid about the aerodynamic characteristics and flow fields of wing_grid, which is a wingtip device that mimics the shape of birds. Then, Mach number effect of wing_grid is investigated.

Reasons and benefits of using JAXA Supercomputer System

In order to conduct three-dimensional CFD, a huge computatinal memories and costs are required. It is almost impossible to have a computation by the workstation at our laboratory. So it is nessesary to conduct our reseach with a super-computer.

Achievements of the Year

In this year, numerical simulation of Mach number 0.20 (low subsonic speed and imcompressible flow) and 0.74 (transonic speed and compressible flow) were conducted, and the differences between two flow fiedls are discussed. Figure 1 shows the flow fiedls around wing_grid at angle of attack 6 deg with Mach number 0.20 and 0.74. As the result, it is observed that the first wingtip of the wing grid has the low pressure region at both Mach numbers. However, at Mach number 0.74, the disturbed　streamline flow is observed from the second wingtip of the wing gird, compared with at at Mach number 0.20. In addition, as shown in Fig. 1(b), the pressure contour line at Mach number 0.74 can be seen to be dense and the pressure difference becomes larger. Therefore, it is tought that the shock wave of the flow field is generated, and　the shock stall occurs.



(a) Mach number 0.20 (b) Mach number 0.74

Fig. 1: Different flow fields around wing_grid at angle of attack 6 deg

Publications

N/A

Usage of JSS

Computational Information

Process Parallelization Methods	N/A
Thread Parallelization Methods	Automatic Parallelization
Number of Processes	1
Elapsed Time per Case	300 Minute(s)

- **Resources Used(JSS2)**

Fraction of Usage in Total Resources[*1](%): 0.01

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
SORA-MA	57,042.85	0.01
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	162.12	0.15
/data	3,287.00	0.06
/ltmp	1,302.08	0.11

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.

- **Resources Used(JSS3)**

Fraction of Usage in Total Resources[*1](%): 0.00

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	0.00	0.00
TOKI-RURI	0.00	0.00
TOKI-TRURI	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2](%)
/home	162.12	0.11
/data	3,287.00	0.06
/ssd	63.58	0.03

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.