Research and Development of Emission Free Aircraft Technologies

● **Responsible Representative**

Akira Nishizawa, Aeronautical Technology Directorate

● **Contact Information**

Yuzuru Yokokawa(yokokawa.yuzuru@jaxa.jp)

● **Members**

Masaya Funada, Atsushi Hashimoto, Hiroshi Kobayashi, Taisuke Nambu, Takayuki Sakurai, Keisuke Sugaya, Yoshiharu Tamaki, Hirotaka Tsutsui, Keiji Ueshima, Kanako Yasue, Yuzuru Yokokawa

● **Abstract**

With the ultimate goal of achieving emission-free (zero emissions) aircraft, research and development of electric hybrid propulsion system is conducted, which includes the WAT(Wake Adaptive Thruster) fans at the end of fuselage, and new configuration of electric aircraft that apply them, as well as system demonstration project.

Ref. URL: https://www.aero.jaxa.jp/eng/research/frontier/feather/

● **Reasons and benefits of using JAXA Supercomputer System**

The JSS3 is used to design a passenger aircraft equipped with an turbo-electric hybrid propulsion system. Because a huge computational resource is required to handle both thermodynamics and aerodynamics, JSS3 is essential for the execution of this research and development.

● **Achievements of the Year**

This year, three analyses were conducted. One of them is the multi objective optimization of the aerodynamic shape of the electric hybrid aircraft with WAT fans. FaSTAR-Move with the actuator disk was used as the solver to find low drag shape of the WAT fan nacelle. In addition, we conducted an analysis to define a model shape which is used in the transonic wind tunnel test to be conducted in the next fiscal year using UTCart, a solver owned by the University of Tokyo. (Fig. 1) The third is an analysis to study the SACOC (Surface Air Cooled Oil Cooler) fins for electric motors and their demonstration systems. FaSTAR was also used as a solver to simulate a demonstration in the high-altitude environment test facility. (Fig. 2)
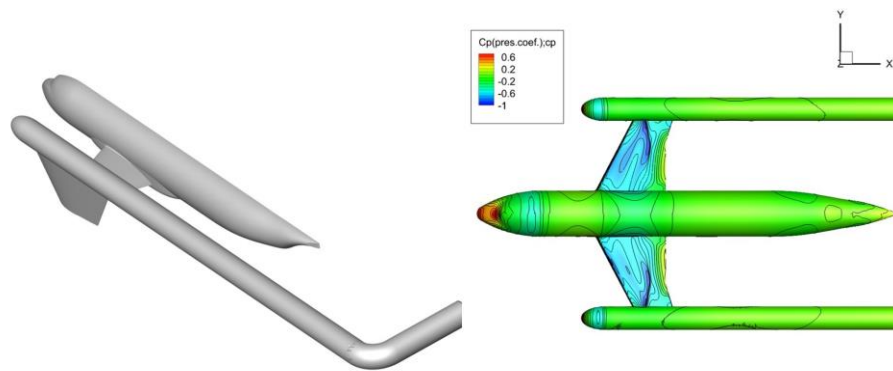
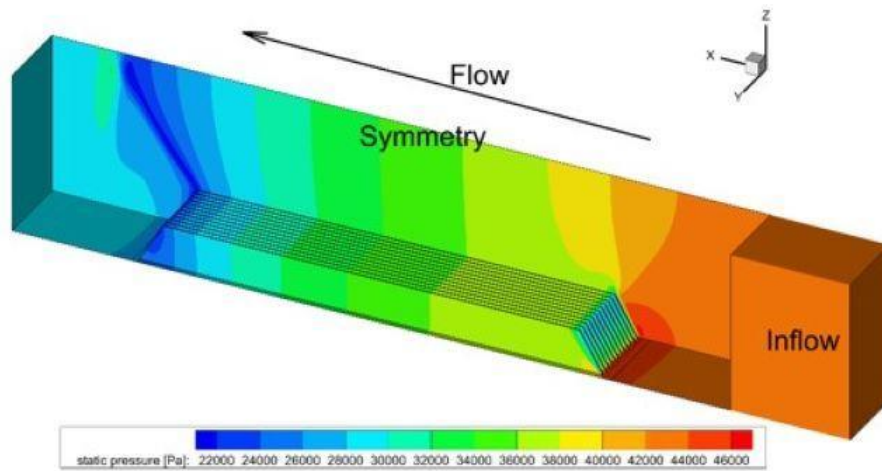Fig. 1: Simulation of an electric hybrid aircraft model equipped with a WAT fan in transonic wind tunnel.

Fig. 2: Simulation of the SACOC fin in high altitude test facility.

● **Publications**

N/A

● **Usage of JSS**

● **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	36 - 768
Elapsed Time per Case	12 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.50

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	13,231,661.42	0.60
TOKI-ST	2,106.81	0.00
TOKI-GP	0.00	0.00
TOKI-XM	293.89	0.16
TOKI-LM	8,433.27	0.64
TOKI-TST	0.00	0.00
TOKI-TGP	0.00	0.00
TOKI-TLM	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2] (%)
/home	1,157.87	0.96
/data and /data2	152,805.83	0.94
/ssd	32,420.21	3.06

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	19.06	0.07

[*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.

● **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage[2] (%)
ISV Software Licenses (Total)	973.51	0.44

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