Research and Development of Emission Free Aircraft Technologies

● **Responsible Representative**

Akira Nishizawa, Aeronautical Technology Directorate

● **Contact Information**

Yuzuru Yokokawa(yokokawa.yuzuru@jaxa.jp)

● **Members**

Atsushi Hashimoto, Hiroshi Kobayashi, Taisuke Nambu, Takayuki Sakurai, Keisuke Sugaya, Marie Tanno, 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 feasibility study of technical demonstration systems.

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**

Two analyses were performed. One of them was the aerodynamic shape design of an electric hybrid aircraft with a fuselage WAT fan. FaSTAR-Move with an actuator disk function was used as a solver, and analyses were performed for varying the fuselage tail and WAT fan nacelles, as well as for simulating wind tunnel tests (Figure 1). The other analysis was performed for the SACOC (Surface Air Cooled Oil Cooler) fins used to cool the electric motor, using FaSTAR as the solver, and parametric studies were conducted on fin height, spacing, and geometry. (Figure 2)
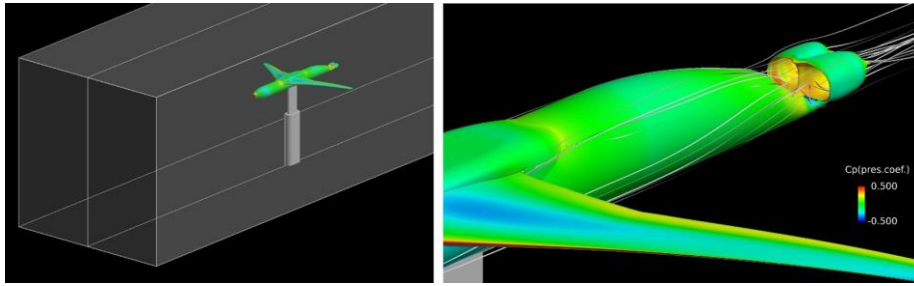
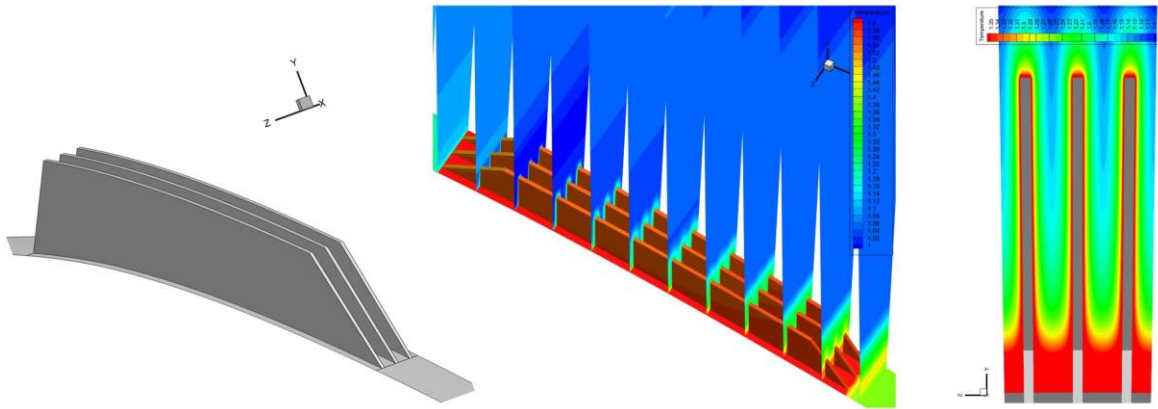Fig. 1: Simulation of an electric hybrid aircraft model equipped with a WAT fan in lowspeed wind tunnel.

Fig. 2: Static temperature contour around the SACOC fins.

● **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](%): 0.13

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	3,287,627.92	0.14
TOKI-ST	5,868.99	0.01
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	861.68	0.06
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	182.50	0.17
/data and /data2	48,884.88	0.38
/ssd	2,142.69	0.30

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	20.27	0.09

[*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)	1,193.53	0.83

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