# Aerodynamic Analysis for High-speed rotorcraft

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## Abstract

Rotorcrafts have complex mechanisms around the main rotor and are exposed to non-streamlined shape parts, resulting in large aerodynamic drag. The aerodynamic drag of the hub accounts for 30% of the total drag of the helicopter. Reducing drag is expected to enable rotorcraft to achieve higher speeds. This work researches and develops devices to reduce rotorcraft drag, including around the hub.

## Reasons and benefits of using JAXA Supercomputer System

Large-scale analysis is required to reproduce the complex geometry of rotorcraft, and analysis cannot be performed without the computational resources of a supercomputer.

## Achievements of the Year

The aerodynamic drag of the helicopter is evaluated using the unstructured CFD code FaSTAR developed at JAXA. Prediction accuracy and changes in aerodynamic forces due to flowfield interference are investigated based on wind tunnel tests of a rotorcraft conducted in the JAXA 2m x 2m low-speed wind tunnel. The results of numerical simulations show good agreement with the wind tunnel test. It is found from the numerical simulation that the interference between the drag reduction device and the fuselage causes changes in the aerodynamic forces of the overall helicopter, providing important knowledge for the design of drag reduction devices.

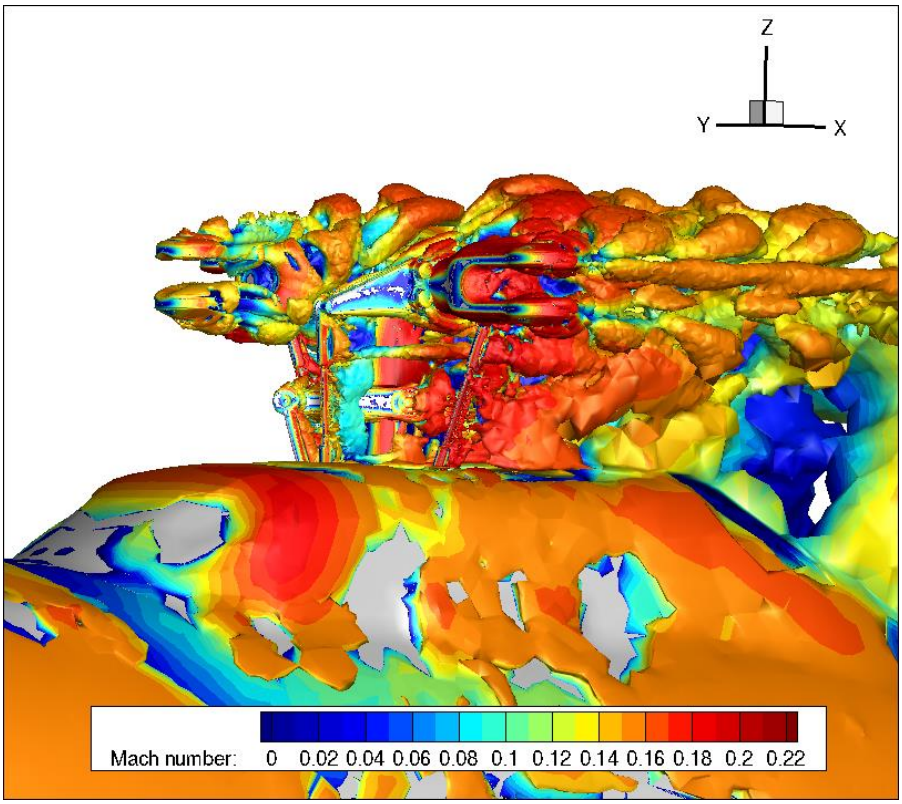


Fig. 1: Flowfield around the rotor hub

## Publications

- Non peer-reviewed papers

Higo, A., et. al, "A Study of Main Rotor Hub Drag Reduction Using CFD and Wind tunnel," Aircraft symposium 2023.

## Usage of JSS

### Computational Information

| | |
|---|---|
| Process Parallelization Methods | MPI |
| Thread Parallelization Methods | N/A |
| Number of Processes | 10 - 20 |
| Elapsed Time per Case | 504 Hour(s) |

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.91

Details

| Computational Resources | | |
|---|---|---|
| System Name | CPU Resources Used (core x hours) | Fraction of Usage[*2](%) |
| TOKI-SORA | 9,379,316.15 | 0.42 |
| TOKI-ST | 4,474,456.48 | 4.83 |
| TOKI-GP | 0.00 | 0.00 |
| TOKI-XM | 0.00 | 0.00 |
| TOKI-LM | 74.68 | 0.01 |
| 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 | 290.66 | 0.24 |
| /data and /data2 | 129,332.74 | 0.80 |
| /ssd | 586.95 | 0.06 |

| Archiver Resources | | |
|---|---|---|
| Archiver Name | Storage Used (TiB) | Fraction of Usage[*2] (%) |
| J-SPACE | 7.19 | 0.03 |

[*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) | 42.01 | 0.02 |

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