

Research of High-Speed Rotorcraft Technologies

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● Abstract

Aiming to achieve a flight speed as high as twice of the conventional helicopters, a new concept of compound helicopter is proposed. Key technologies such the system integration, remarkable reduction of the aerodynamic drag and optimized rotor design are investigated.

Ref. URL: <http://www.aero.jaxa.jp/eng/research/frontier/rotary>

● Reasons and benefits of using JAXA Supercomputer System

The newly proposed compound helicopter utilizes 4 rotor/propellers. CFD analysis involving the whole aircraft requires large amount of memories and long-time computations. Super-computers such as the JSS2 is a must infrastructure for this kind of research.

● Achievements of the Year

To obtain validation data for CFD analysis, a compound helicopter scaled-down model was tested in a wind-tunnel. A flap is added to the fixed-wing under the main rotor, the landing gear can be stored inside the fuselage during forward flight and a fairing is added to the main rotor hub to further reduce the drag of the aircraft. Also, to reduced the drag caused by the rotor/wing interaction, a new technology is propped and it is confirmed through wind-tunnel testing and also CFD simulations. Samples of overlapped moving grids used by rFlow3D, a CFD code specifically developed for rotorcraft is shown in Fig. 1. A flowfield around a rotor and a fixed-wing is shown in Fig. 2. A sample of CFD analysis for a whole compound helicopter is shown in Fig. 3.

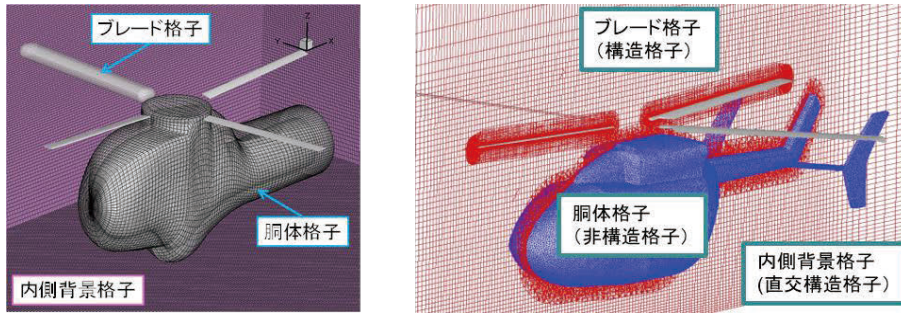


Fig. 1: Moving overlapped grids for rFlow3D

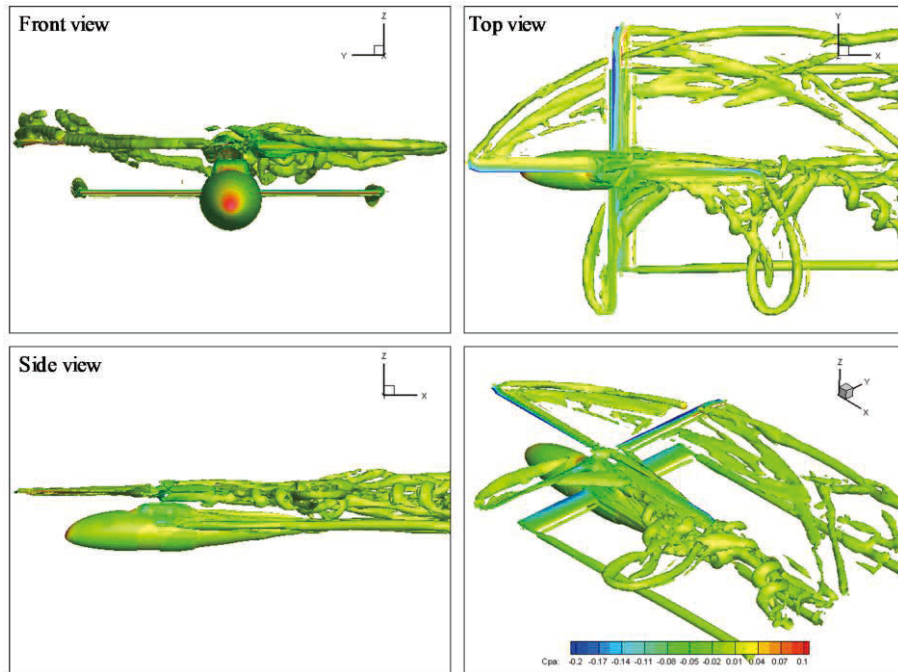


Fig. 2: Flowfield around a rotor with a fixed-wing

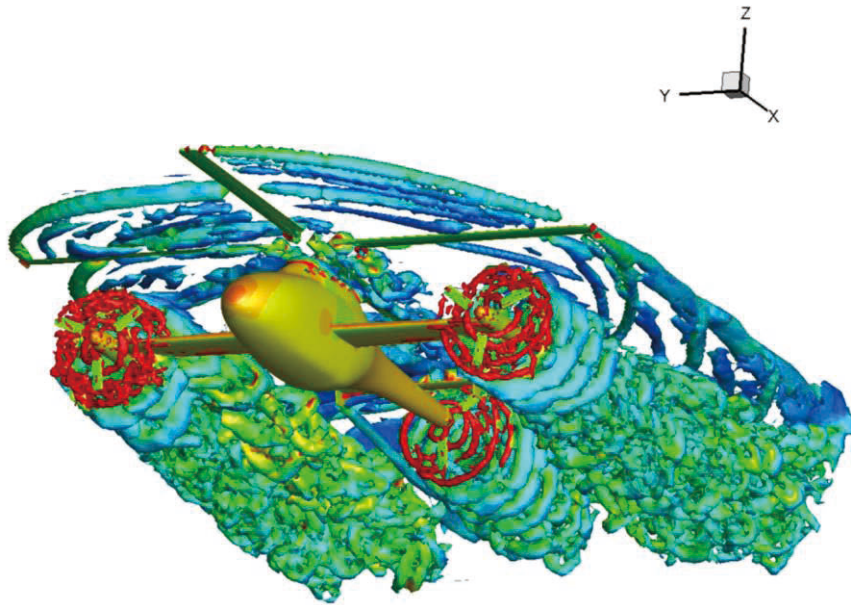


Fig. 3: A sample of CFD analysis for a full configured compound helicopter

● **Publications**

- Peer-reviewed papers

1) Hideki Sugawara, Yasutada Tanabe: Numerical Investigation of Rotor/Wing Aerodynamic Interactions at High Advance Ratios, Journal of Aircraft, Vol. 56, No. 6, pp.2285-2298, November-December 2019.

- Non peer-reviewed papers

1) Hideaki Sugawara, Yasutada Tanabe, Masaharu Kameda, Effect of Lift Share Ratio on the Aerodynamic Performance of a Winged Compound Helicopter, 8th Asian/Australian Rotorcraft Forum, Ankara, Turkey, Oct. 30 - Nov. 2, 2019.

● **Usage of JSS2**

● **Computational Information**

| | |
|---------------------------------|-------------|
| Process Parallelization Methods | N/A |
| Thread Parallelization Methods | OpenMP |
| Number of Processes | 1 |
| Elapsed Time per Case | 240 Hour(s) |

- **Resources Used**

Fraction of Usage in Total Resources*1(%): 0.35

Details

| Computational Resources | | |
|-------------------------|---------------------------------------|------------------------|
| System Name | Amount of Core Time (core x hours) | Fraction of Usage*2(%) |
| SORA-MA | 650,636.93 | 0.08 |
| SORA-PP | 281,727.54 | 1.82 |
| SORA-LM | 0.00 | 0.00 |
| SORA-TPP | 276,790.79 | 16.71 |

| File System Resources | | |
|-----------------------|------------------------|------------------------|
| File System Name | Storage Assigned (GiB) | Fraction of Usage*2(%) |
| /home | 123.69 | 0.10 |
| /data | 5,918.56 | 0.10 |
| /ltmp | 680.63 | 0.06 |

| 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.