Research on the rotorcraft aerodynamics and noise prediction technologies

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Abstract

We aim at the development of aerodynamics and noise computation techniques for rotorcrafts by the unstructured-grid CFD code FaSTAR-Move that utilizes an overset moving grid approach. Extracting the unsteady CFD data obtained by FaSTAR-Move onto the noise source control surface defined around rotor blades, noise propagation is analyzed by iAWESOME a fast acoustic-equation solver that can consider noise-shielding effect as a coupled approach.

Reasons and benefits of using JAXA Supercomputer System

In this research topic, real-scale complicated models must be computed with real flow conditions, which requires large computer resources and is suited to the use of the JAXA supercomputer system.

Achievements of the Year

In this fiscal year, the interface for coupled analysis was developed extensively between FaSTAR-Move that provides near-field noise sources and iAWESOME that solves noise propagation in the frequency domain. Now, time history data obtained by FaSTAR-Move are projected onto the noise-source surfaces imported by iAWESOME after FFT is applied. In addition, a fast volumetric mapping function for flow-field is newly introduced from CFD to acoustic field. The coupled analysis function developed this year was applied to the HART-II benchmark problem. It was confirmed that the three-dimensional acoustic field is converged very fast at each discrete frequency to compute the BVISPL noise carpet.

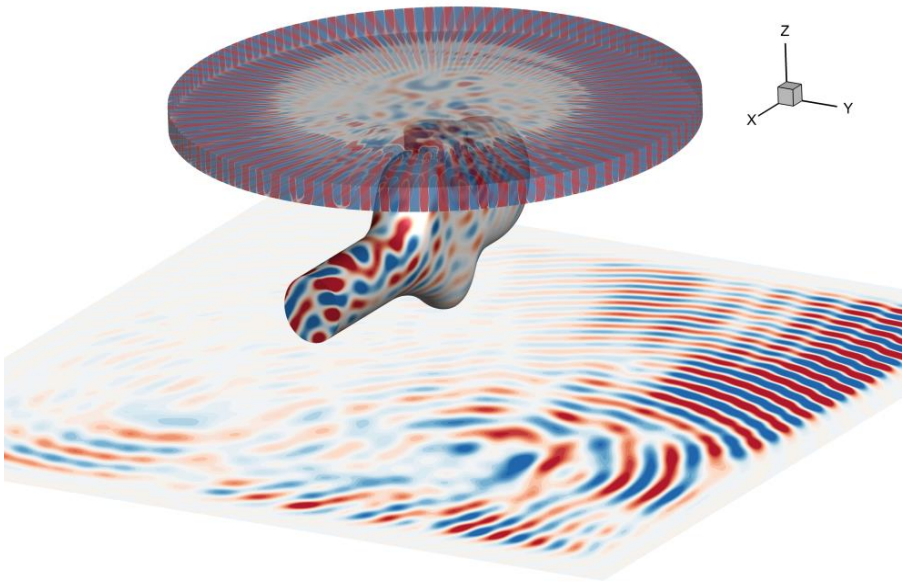

Fig. 1: Obtained results of HART-II model by FaSTAR-Move/iAWESOME coupling approach (instantaneous field, frequency: 21BPF)

Publications

- Oral Presentations

1) IKEDA Tomoaki, "On the effects of vortical motions on noise source surface for the acoustic wave equation in inhomogeneous medium," the 56th Fluid Dynamics Conference/the 42nd Aerospace Numerical Simulation Symposium, 2024.

2) YASUE Kanako, "On the advanced research of the airframe characteristics prediction toward the enhanced social acceptance of next generation air-mobility," the 20th Molecular Imaging Forum in Interdisciplinary Fields, 2024.

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	96 - 960
Elapsed Time per Case	200 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.62

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	16,343,894.92	0.75
TOKI-ST	23,055.22	0.02
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	409.49	0.03
TOKI-TST	0.15	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	1,213.59	0.82
/data and /data2	127,554.55	0.61
/ssd	30,720.00	1.65

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	7.01	0.02

*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)	105.45	0.07

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