CFD Analysis of Wind Fields Around Regional Airports

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Abstract

Sudden changes in low-level wind conditions around airports pose a potential risk to aircraft during takeoff and landing. This project aims to improve the situational awareness of pilots and flight dispatchers by predicting and visualizing terrain-induced turbulence in the atmospheric boundary layer based on LES analysis, thereby enhancing safety.

Reasons and benefits of using JAXA Supercomputer System

CFD analysis of several hundred million points is required to resolve topographical turbulence in the atmospheric boundary layer and to study aircraft dynamics. This requires the use of a supercomputer such as JSS3, which boasts large memory capacity and high computational performance.

Achievements of the Year

We analyzed terrain-induced turbulence at several airports in Japan using a solver specialized for wind analysis over actual terrain. The results were verified by comparing them with observed wind data. The mechanism of terrain-induced turbulence that causes aircraft turbulence was clarified, and the conditions and locations of its occurrence were identified. Furthermore, it was confirmed that the simulations correctly reproduced the spatio-temporal characteristics of the turbulence through comparison with observed data.

Publications

- Oral Presentations

Hiroki Tadakawa, Yuka Fujita, Midori Maki, Takanori Uchida: A study of Turbulence Visualization System for Landing Safety at Regional Airports: Wind Observation at Okinoerabu Airport, 62nd Aircraft Symposium, 2024.

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	1 - 36
Elapsed Time per Case	12 Hour(s)

JSS3 Resources Used

Fraction of Usage in Total Resources[*1](%): 0.07

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	0.00	0.00
TOKI-ST	600,737.11	0.62
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	0.00
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	98.00	0.07
/data and /data2	56,124.00	0.27
/ssd	1,004.00	0.05

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	4.28	0.01

*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)	0.00	0.00

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