Research and Development of Aircraft Design DX

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Abstract

This project is in response to NEDO's project of "Key and Advanced Technology R&D through Cross Community. Collaboration Program/Development and Demonstration of Advanced Technologies for Developing and Manufacturing Processes Using Digital Technologies for Designing, Manufacturing, and Certifying Aircraft" (hereinafter referred to as "K-Pro"). Currently, domestic heavy industry manufacturers and JAXA are jointly performing this project. In the period from FY2023 to FY2027, K-Pro is required to implement four major items, one of which is the design DX of this project. The theme of design DX is the innovation of the conceptual design flow, and the aim is to reduce the rework period by 30% by introducing MBSE-MBD linkage in the design process from the aircraft level to the component level. JAXA will be mainly responsible for the MBD part of aircraft and engines, and will contribute to the achievement of the above goals by improving the fidelity of aerodynamic analysis and other aspects at an early stage of design. Specifically, the goal is to complete the evaluation of the required aerodynamic performance of aircraft design candidates provided by heavy industries within the specified period through CFD analysis, etc., and to create a database of cascade analysis results that will contribute to the design of engines.

Reasons and benefits of using JAXA Supercomputer System

In this project, it is necessary to evaluate various aerodynamic performance by CFD analysis for a very large number of design candidates and design conditions provided by heavy industry manufacturers. In order to do so, it is necessary to have computing resources that can evaluate a very large number of candidates by numerical analysis at the necessary timing, while ensuring security recognized by heavy industry manufacturers. There is no other company that can meet these conditions, except for JSS.

Achievements of the Year

Regarding the contribution to the conceptual design flow for the entire aircraft, a reduced order model (ROM) is constructed based on the CFD analysis results in order to evaluate a lot of shapes. After narrowing down the number of individuals based on the evaluation results from ROM, CFD analyses are conducted for better design individuals. In order to carry out the above, the entire work was automatized, i.e., generating a large number of aircraft shapes, constructing a grid, and performing CFD analysis was automated by linking JSS and the other computers. We made a flow field database as reference data for improving the accuracy of RANS analysis targeting engine compressors, utilizing detailed analysis with DES/LES and we were able to make a flow field database.

Publications

N/A

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	Automatic Parallelization
Number of Processes	480 - 960
Elapsed Time per Case	1 Hour(s)

JSS3 Resources Used

Fraction of Usage in Total Resources[*1](%): 0.84

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	40,254,961.22	1.82
TOKI-ST	67,983.08	0.07
TOKI-GP	1.06	0.00
TOKI-XM	32,571.65	17.84
TOKI-LM	23,293.47	1.77
TOKI-TST	108.92	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	4,512.72	3.75
/data and /data2	404,081.97	2.49
/ssd	5,548.42	0.52

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	15.52	0.06

*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)	1,592.04	0.72

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