Development of Aerodynamic Optimization Library: Harmonee

Report Number: R22EA3202
Subject Category: Aeronautical Technology
URL: https://www.jss.jaxa.jp/en/ar/e2022/20741/

Responsible Representative

Atsushi Hashimoto, Manager, Aviation Technology Directorate, Aircraft Lifecycle Innovation Hub

Contact Information

Mami Hayakawa(hayakawa.mami@jaxa.jp)

Members

Atsushi Hashimoto, Mami Hayakawa, Takashi Ishida, Masahiro Kanazaki, Shigeru Kuchiishi, Katsuhito Kozawa, Kohji Suzuki, Yukinori Morita, Takatoshi Nakayama, Shinsuke Nishimura, Kei Nakanishi, Takuya Ogura, Tetsuji Ogawa, Kyohei Sawada, Kazufumi Uwatoko, Minoru Yoshimoto

Abstract

An aerodynamic optimization library "Harmonee," which uses the unstructured CFD code FaSTAR, is develped and its validity and efficiency are examined. A Multi-Objective Evolutionary Algorithm (MOEA) is employed as an aerodynamic optimization method. This tool is aimed to enable the direct evolutionary computing to perform within a practical computational time by utilizing the high speed performance of FaSTAR. In the present project, basic programs are developed and validated using JSS.

Reasons and benefits of using JAXA Supercomputer System

Aerodynamic optimization using an evolutionary algorithm requires a number of high-fidelity and large-scaled computations (3D RANS analysis) and needs to use the supercomputer.

Achievements of the Year

The surrogate model assisted module of 'Harmonee' and 'FaSTAR-Move', unstructured CFD code developed by JAXA, were applied to the multi-objective aerodynamic optimization problem for the wing-pylon-nacelle configuration of NASA Common Research Model(CRM).

Publications

N/A

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	Automatic Parallelization
Number of Processes	128
Elapsed Time per Case	2 Hour(s)

JSS3 Resources Used

Fraction of Usage in Total Resources[*1](%): 0.06

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	224,346.24	0.01
TOKI-ST	12,707.33	0.01
TOKI-GP	0.00	0.00
TOKI-XM	24,004.68	15.02
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	531.65	0.48
/data and /data2	112,379.26	0.87
/ssd	368.83	0.05

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	0.28	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.

- **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage*2 (%)
ISV Software Licenses (Total)	10.15	0.01

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