

Development of Aerodynamic Optimization Library: Harmonee

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● Abstract

An aerodynamic optimization library "Harmonee," which uses the unstructured CFD code FaSTAR, is developed 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

We validated the surrogate model assisted module of Harmonee by applying it to aerodynamic optimization problem which satisfies two objectives and two constraints shown in Fig1, according to the flowchart shown in Fig.2.

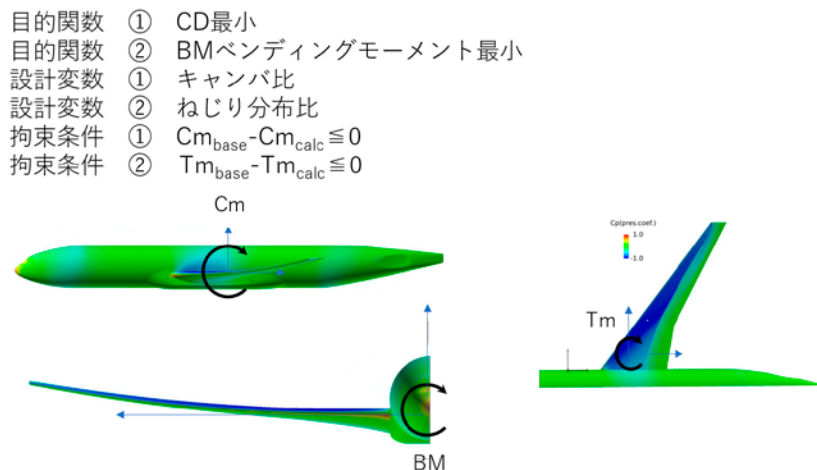


Fig. 1: Optimization problem for NASA Common Research Model

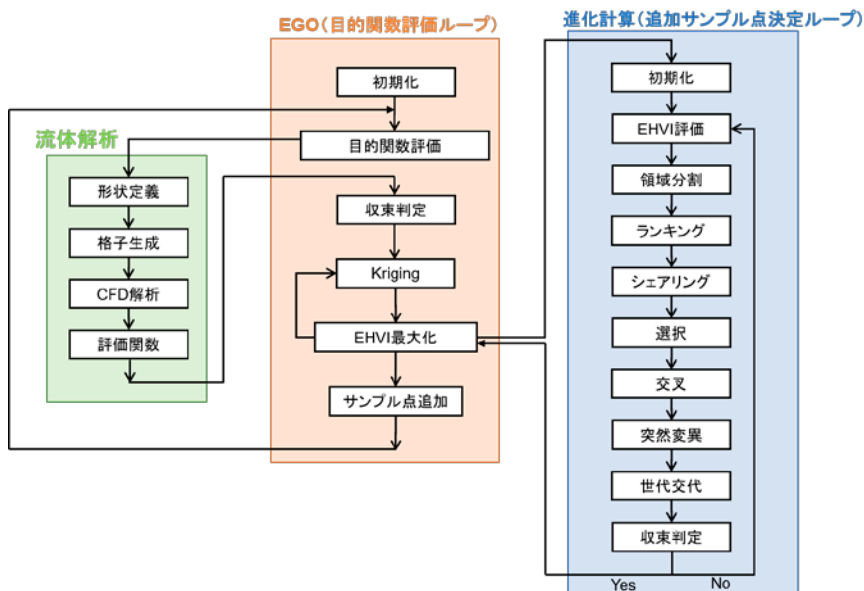


Fig. 2: Flowchart of aerodynamic optimization problem

● 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)

- **Resources Used(JSS2)**

Fraction of Usage in Total Resources^{*1}(%): 0.13

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage ^{*2} (%)
SORA-MA	448,499.84	0.08
SORA-PP	38,128.79	0.30
SORA-LM	492.92	0.29
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage ^{*2} (%)
/home	887.85	0.81
/data	60,388.65	1.17
/tmp	9,546.00	0.81

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage ^{*2} (%)
J-SPACE	0.22	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.

- **Resources Used(JSS3)**

Fraction of Usage in Total Resources*1(%): 0.13

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2(%)
TOKI-SORA	10,831.04	0.00
TOKI-RURI	11,467.42	0.07
TOKI-TRURI	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2(%)
/home	446.30	0.31
/data	93,768.10	1.57
/ssd	256.28	0.13

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2(%)
J-SPACE	0.22	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.