Development of Aerodynamic Optimization Library: Harmonee

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● **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 JSS2.

● **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 our Harmonee module by applying it to a coupled aero-structure optimization problem which satisfies three objectives and two constraints shown in Fig.2, according to the flowchart shown in Fig. 1.
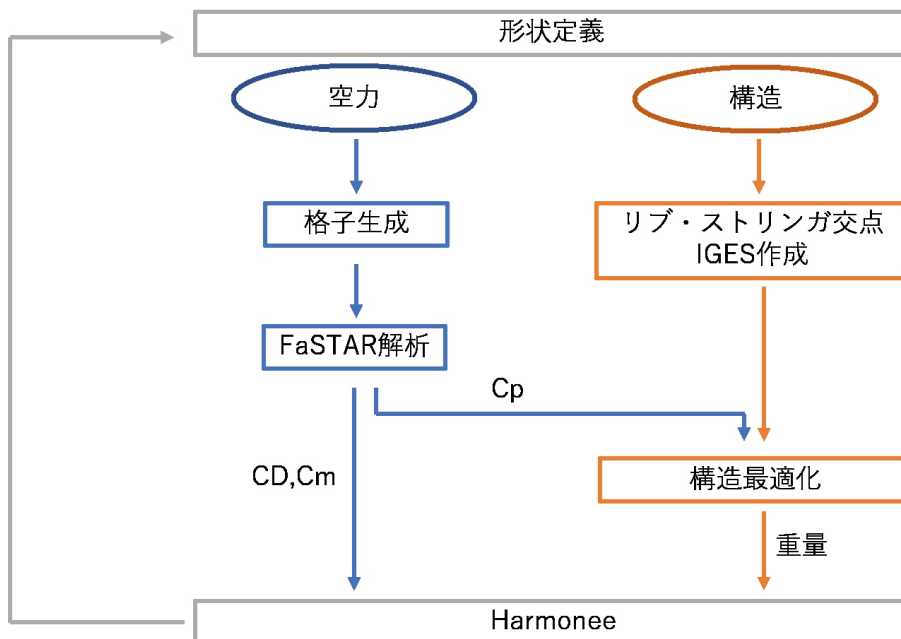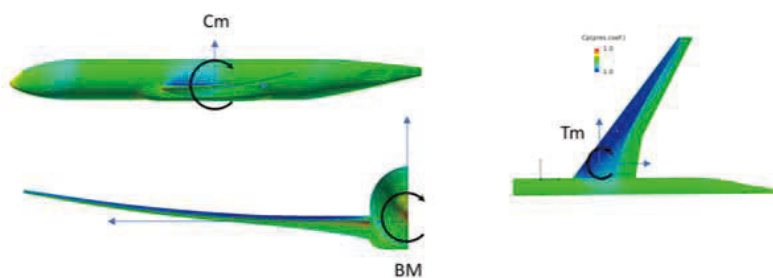
Fig. 1: Flowchart of coupled aero-structure optimization problem

Fig. 2: Optimization problem for NASA Common Research Model

● **Publications**

N/A

● **Usage of JSS2**

● **Computational Information**

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

● **Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.20

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
SORA-MA	1,482,708.63	0.18
SORA-PP	26,609.96	0.17
SORA-LM	12,495.92	5.22
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2](%)
/home	865.85	0.72
/data	63,084.64	1.08
/ltmp	9,528.06	0.81

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2](%)
J-SPACE	0.33	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.