

Development of Aerodynamic Optimization Library: Harmony

Report Number: R18EA3202

Subject Category: Aeronautical Technology

URL: <https://www.jss.jaxa.jp/en/ar/e2018/9083/>

● Responsible Representative

Takashi Aoyama, Aeronautical Technology Directorate, Numerical Simulation Research Unit

● Contact Information

Shigeru Kuchiishi (kuchi-ishi.shigeru@jaxa.jp)

● Members

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

● 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 JSS2.

● Reasons for using JSS2

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

For the evolutionary algorithm module of Harmonee, crossover algorithm and constraint treatment by the directed mating algorithm were improved from the viewpoint of accuracy and robustness. Harmonee was applied to a two-objective, two-constrained aerodynamic optimization problem for the NASA Common Research Model (CRM) and it was found that reasonable parato solutions can be obtained.

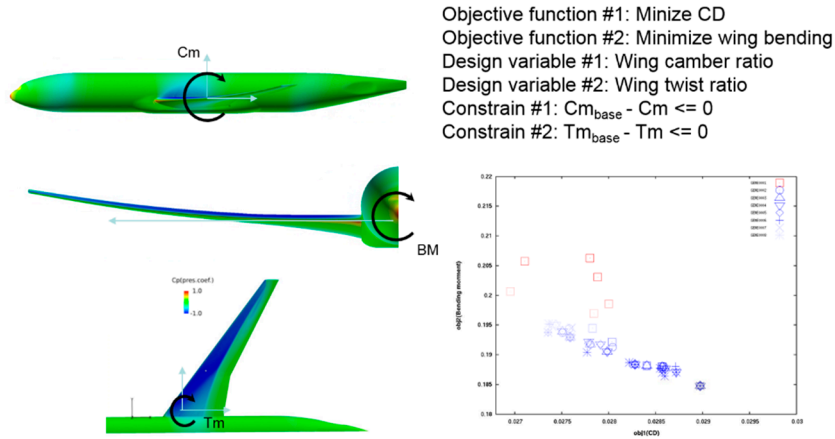


Fig. 1: Two-objective, two-constrained aerodynamic optimization for the NASA Common Research Model (CRM)

● **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 (%): 0.08

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2 (%)
SORA-MA	271,500.66	0.03
SORA-PP	17,732.00	0.14
SORA-LM	0.00	0.00
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2 (%)
/home	747.94	0.77
/data	56,723.65	1.00
/ltmp	9,601.20	0.82

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	0.32	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.