Innovation for Design, Data-acquisition, Trouble-shoot and Certification in Aircraft Development: Aerodynamic Optimization

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Responsible Representative

Takeshi Ito, Aeronautical Technology Directorate, Next Generation Aeronautical Innovation Hub Center

Contact Information

Shigeru Kuchi-Ishi　shigeruk@chofu.jaxa.jp

Members

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

Abstract

An aerodynamic optimization tool using 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 for using of 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 Multi-Objective Evlutionary Algorithm (MOEA), the program was extended to the Non-dominated Sorting Genetic Algorithms-II (NSGA-II) that enables to produce more equable and diversified parate-optimal solutions. Also the directed mating algorithm was introduced to enhance robustness of the program for problems including constraint conditions. The program was applied to a constrained optimization problem for the NASA Common Research Model (CRM) and it was found that the present program can produce optimal solutions more effectively compared to the foregoing program.

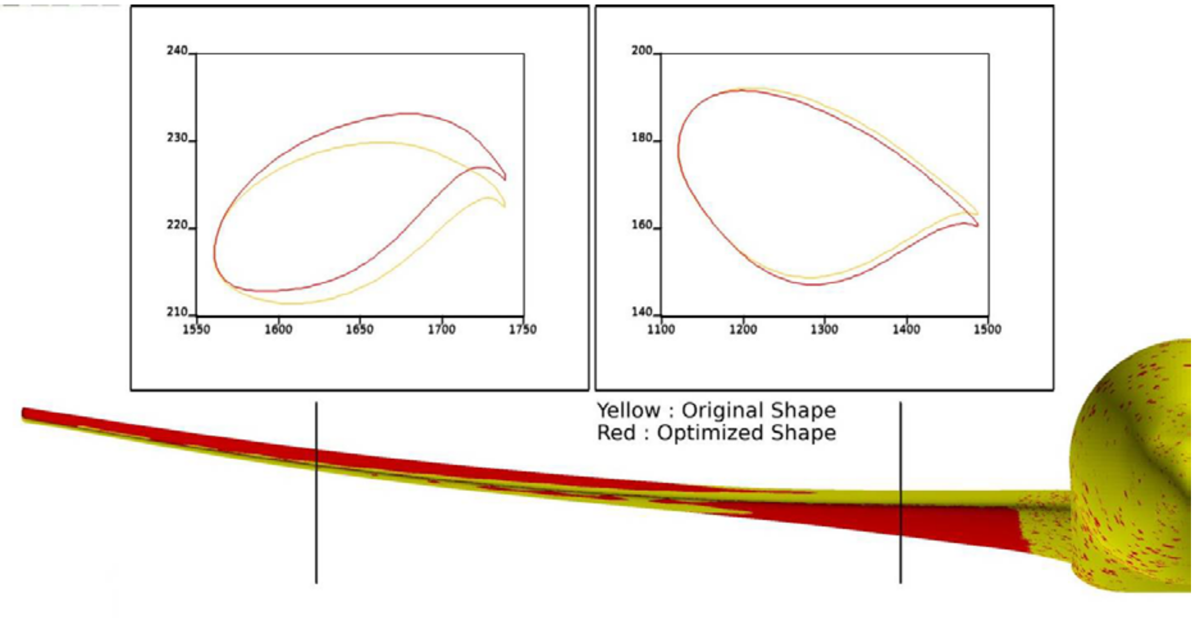

Fig.1 NASA CRM airfoil optimization result

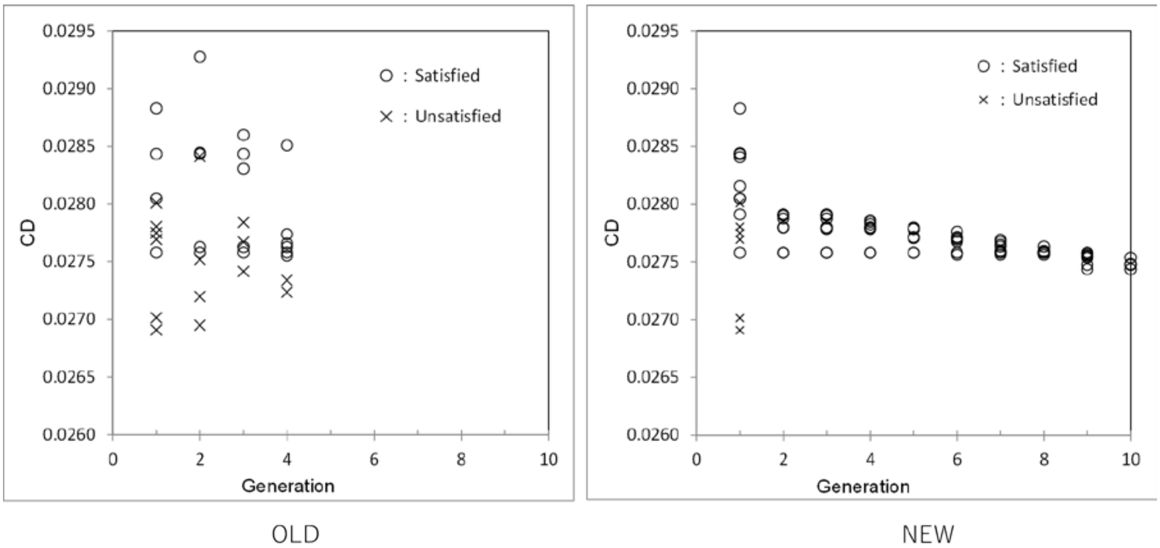

Fig.2 Comparison of the optimal solution convergence history

Publications

- Presentations

1) Kanazaki, M., Kuchi-Ishi, S., and Suzuki K., ``Development of an Aerodynamic Optimization Library by Evolutionary Algorithm,'' FaSTAR User's Conference, Akihabara Convention Hall, 2017.

Usage of JSS2

Computational Information

Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	96 - 512
Elapsed Time per Case	240.00 hours

Resources Used

Fraction of Usage in Total Resources*1 (%): 0.10

Details

Computing Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2 (%)
SORA-MA	356,995.84	0.05
SORA-PP	55,829.90	0.70
SORA-LM	0.02	0.00
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage assigned(GiB)	Fraction of Usage*2 (%)
/home	587.53	0.41
/data	24,481.17	0.45
/ltmp	8,646.34	0.65

Archiver Resources		
Archiver System 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