An attempt to develop a method for modeling holistic phenomena without a prerequisite knowledge

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Abstract

It is important to gain a fast and accurate feedback from computational results in a design process. A traditional way of Computational Fluid Dynamics (CFD) gives physically acceptable results at the costs of tremendous amount of computational resources and time. Our research group is therefore working on a machine-learning-based approach aimed at an innovative design tool.

Reasons and benefits of using JAXA Supercomputer System

High acurracy prediction by machine learning requires a wide variety of data the amount of which should be as large as possible. This conversely indicates poorly predicted results as a consequence of a shortage of data. The combination of the processing capability of JSS2 and a fast algorithm implemented in our CFD code, FaSTAR can serve us a plenty of data within a short period of time and its data productivity is necessary for the success of our research.

Achievements of the Year

We prepared a large number of computational results mainly for two-dimensional NACA airfoils using JSS2(Fig. 1).

We trained a neural network by the results and predicted the flow field around the two-dimensional airfoil by the network.

The prediction of the trained data succeeded to reproduce the original distribution correctly(Fig. 2). And a reproducibility was confirmed in the prediction of untrained data(Fig. 3).

In the future, we aim to improve the reproducibility for machine learning prediction by training the wider variety of data.

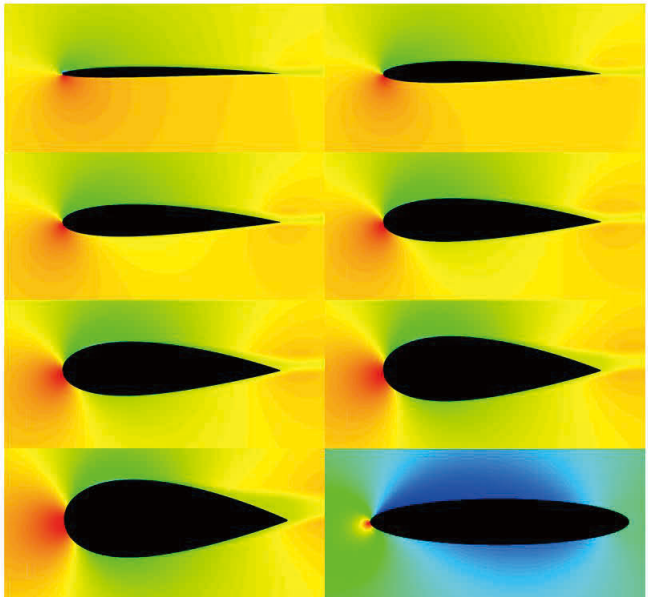

Fig. 1: List of training data made by JSS2

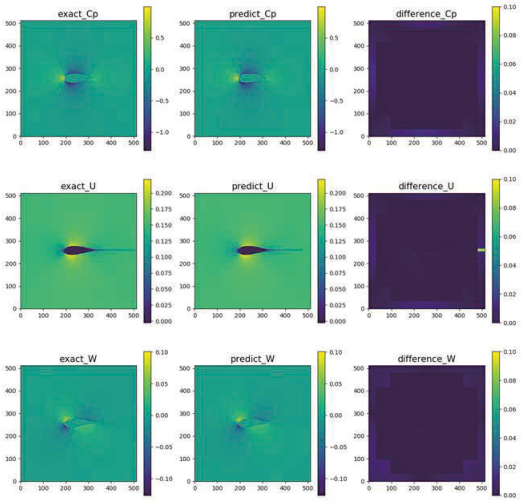

Fig. 2: Prediction result for trained data

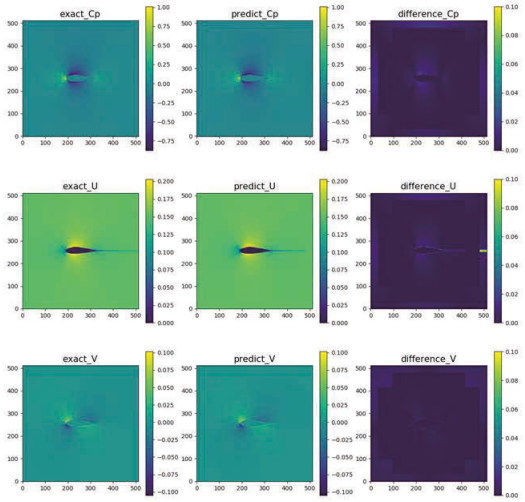

Fig. 3: Prediction result for untrained data

Publications

N/A

Usage of JSS2

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	2 - 64
Elapsed Time per Case	6 Hour(s)

Resources Used

Fraction of Usage in Total Resources[*1](%): 0.04

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
SORA-MA	208,418.77	0.03
SORA-PP	29,811.71	0.19
SORA-LM	1,180.57	0.49
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2(%)
/home	5.96	0.00
/data	6,103.52	0.10
/ltmp	1,220.70	0.10

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2(%)
J-SPACE	0.00	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.