

流体科学研究所 博士前期課程学生海外発表促進プログラム 報告書

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申請者氏名・所属・学年

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発表タイトルと著者

“Deep Learning Techniques for High-Dimensional Surrogate-Based Aerodynamic Design”,
Muhammad Alfiyandy Hariansyah and Koji Shimoyama

1. 研究発表の内

Utilizing surrogate-based optimization (SBO) to solve high-dimensional aerodynamic design is challenging. The difficult part is to train the surrogate model to achieve sufficient accuracy. Surrogate models with poor accuracy might degrade the optimization performance. In this research, I address the issue by incorporating a deep convolutional generative adversarial network (DCGAN)-based sampling and a convolutional neural network (CNN)-based geometric filtering in the SBO procedure. To see the efficacy of our methods, we apply them to solve a lift-constrained drag minimization of the Common Research Model wing with 193 design variables. We also compare our methods with the conventional SBO method that uses a Latin hypercube sampling with Free Form Deformation parameterization. The results show that our proposed methods could achieve improvements over the conventional method by producing more accurate models and achieving faster optimization convergence.

2. 今回の出張・発表で学んだこと

Although I have been presenting my research in several domestic and international conferences before, I was still anxious. It is because unlike previous events, this time is my very first on-site event where I could interact directly with the audience while presenting. For the presentation, I would say it went smooth as I already practiced many times and precisely did time management. For the QnA session, I had one or two tough questions that I did not expect, as well as easy questions. However, the questions really helped me sharpen my reasoning skills, strengthen my research motivation, and gave me different perspectives on my current methods. I also received some suggestions from the audience on how to improve my methods, which is useful for me to advance my research.

For the conference, in general, it was really a rewarding experience, as I was able to listen to many great lectures/talks from experts in the industry and academia, e.g., Boeing, Airbus, NASA, JAXA, Georgia Tech, to name a few. I could also make friends with other students from different universities around the globe, e.g., Univ of Michigan, Cranfield University, the Univ of Tokyo, etc., and got to learn their research. There was also a speed mentoring program where

students were grouped and got to ask career-related questions to the mentors from industry and academia. This program gave me guidance on my career direction after graduation. Overall, it was a really enriching experience for me.

3. 本プログラムへの感想

I never knew this program existed, until my supervisor told me about it. This is a good program that helps students gain access to great conferences around the globe. Presenting at an overseas conference is not only about preparing the research, but also the trip and accommodation which of course will incur costs. Providing students with financial resource to support their trip is important to make them worry less about the cost and focus more on their research. I am also grateful that this program offered me an early reimbursement prior to the conference, so that I could spend my own money for other needs. I encourage future students with prospective research to apply to this program.

4. 指導教員所見

数年にわたるコロナ禍の中で積み重ねてきた研究の成果を論文にまとめ、査読を経て、久しぶりの対面開催となった本国際会議での口頭発表を成し遂げた、当該学生のこれまでの努力を評価したい。当日の口頭発表には、多数の聴講者が訪れ、数々の質問と指摘を受けた。語学的には特に問題なく対応できたが、研究内容的には更なる再考を求める点も見受けられた。以上の経験を踏まえて、これまでの研究成果を多角的に見直し、本研究を今後より良い方向に発展できることを期待している。

5. 発表時の写真など



Introduction Problem Formulation Methodologies Results and Discussion

Why surrogate modeling?

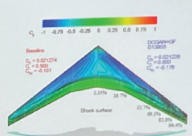
Aerodynamic Design Optimization

explore and analyze many design configurations

High-fidelity CFD for fluid analysis is **expensive**
(hours/days for one design)

Need for a fast and accurate fluid analysis

Surrogate modeling
Analytically map input to output using a mathematical model



Design Variables: $x_1, x_2, \dots, x_n$

Multilayer perceptron

Outputs: C_D Drag, C_L Lift, C_{M_y} Moment

Hariansyah & Shimoyama

Introduction: why surrogates?

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