

SHUGO KANEKO

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EDUCATION

University of Michigan, Ann Arbor, MI

Ph.D., Aerospace Engineering and Scientific Computing (GPA 4.0/4.0)

Sep. 2019 – May 2024

M.S.E., Aerospace Engineering (4.0/4.0)

Sep. 2019 – Dec. 2022

Kyushu University, Fukuoka, Japan

B.Eng., Aerospace Engineering (3.9/4.0)

Apr. 2014 – Mar. 2019

RESEARCH EXPERIENCE

Postdoctoral Research Fellow, University of Michigan

May 2024 – Present

Multidisciplinary Design Optimization Lab (PI: Prof. Joaquim R. R. A. Martins)

- Developing aircraft conceptual design optimization library using OpenMDAO in collaboration with an aviation startup.
- Implementing a sequential quadratic programming (SQP) solver in Python for research use.

Graduate Student Research Assistant

Sep. 2019 – Apr. 2024

Ph.D. advisor: Prof. Joaquim R. R. A. Martins

Conceptual design optimization of eVTOL aircraft

- Performed design space exploration for a hybrid-electric 3000-lb VTOL aircraft and an all-electric 20-lb UAV.
- Solved nonlinear optimization to minimize aircraft weight considering aerodynamics, propeller performance, motor and battery sizing, and vehicle dynamics.

Simultaneous design and trajectory optimization of electric UAVs

- Implemented a multidisciplinary model combining UAV conceptual design and takeoff trajectory optimization using OpenMDAO and optimized vehicle design for the minimum energy consumption.
- Solved the MDO problem computationally efficiently by parallelizing the model evaluation and using gradient-based optimization (SNOPT and IPOPT via pyOptSparse).
- Proposed new linear solver strategies to accelerate direct/adjoint sensitivity analysis for gradient-based optimization.
- Investigated conceptual design of various UAV configurations: fixed-wing, lift+cruise, and tailsitter.

Fleet design and routing optimization for drone delivery

- Implemented and solved coupled optimization of UAV design, fleet sizing and composition, and delivery routing.
- Wrote Python code to combine an OpenMDAO-based sizing model and a routing solver by Google OR-Tools.
- Proposed and benchmarked a heuristic method that can effectively solve mixed-integer optimization.

SKILLS

Research skills	MDO/MDAO, Aircraft/drone conceptual design, Trajectory simulation, Optimal control, Aerodynamic analysis, Structural analysis, Gradient-based optimization, Adjoint method, Mixed-integer optimization, Parallel computing, Surrogate modeling
Programming	Python (proficient), C++, Fortran, Julia, MATLAB.
Library/software	OpenMDAO, IPOPT, SNOPT, pyOptSparse, Gurobi, CVXPY, Google OR-Tools, CAD (Autodesk Fusion 360, SolidWorks), MSC NASTRAN/PATRAN, Tecplot, OpenAeroStruct (VLM), Dymos (optimal control), CCBlade (BEMT)
Others	Git/GitHub, Linux, Latex, Microsoft Office

PUBLICATIONS

Refereed Journal Article

- [J4] **S. Kaneko** and J. R. R. A. Martins, “Simultaneous Optimization of Design and Takeoff Trajectory for an eVTOL Aircraft,” *Aerospace Science and Technology*, under review.
- [J3] **S. Kaneko**, E. Adler, J. Gray, J. Jasa, and J. R. R. A. Martins, “Accelerating Derivative Computations Using the Functional Form for Coupled Systems,” *Optimization and Engineering*, under review.
- [J2] **S. Kaneko** and J. R. R. A. Martins, “Simultaneous Design and Trajectory Optimization Strategies for Computationally Expensive Models,” *AIAA Journal*, under review.
- [J1] **S. Kaneko** and J. R. R. A. Martins, “Fleet Design Optimization of Package Delivery Unmanned Aerial Vehicles Considering Operations,” *Journal of Aircraft*, 2023.

Conference Papers

- [C6] **S. Kaneko** and J. R. R. A. Martins, “MDO Formulations for Simultaneous Design and Trajectory Optimization,” *AIAA SciTech Forum*, Orlando, FL, 2024.
- [C5] J. Exalto, B. Pacini, **S. Kaneko**, and J. R. R. A. Martins, “Rapid Aerostructural Optimization of Wing-Propeller Systems,” *AIAA SciTech Forum*, Orlando, FL, 2024.
- [C4] **S. Kaneko** and J. R. R. A. Martins, “Simultaneous Optimization of Conceptual Design and Takeoff Trajectory of a Lift-Plus-Cruise UAV,” *10th Autonomous VTOL Technical Meeting*, Mesa, AZ, 2023.
- [C3] **S. Kaneko** and J. R. R. A. Martins, “Fleet Design Optimization of Package Delivery UAVs Considering Operations,” *AIAA SciTech Forum*, San Diego, CA and Online, 2022.
- [C2] **S. Kaneko**, H. Nagai, and S. Yashiro, “Kinematic Optimization of a Flapping Wing under Asymmetric Motion and its Aerodynamic Effects,” *56th Aircraft Symposium*, Yamagata, Japan, 2018. (*in Japanese*)
- [C1] **S. Kaneko**, H. Nagai, S. Yashiro, K. Fujita, and M. Murozono, “Aeroelastic Planform Optimization of a Resonant-Driven Flapping Wing,” *Japan Society for Aeronautical and Space Sciences (JSASS) Western Branch Conference*, Fukuoka, Japan, 2018. (*in Japanese*)

Presentations (without a paper)

- [P2] Control Co-Design of Aircraft and UAVs Using OpenMDAO, *NSF Control Co-Design Workshop*, Urbana, IL, May 2023.
- [P1] Multidisciplinary Design Optimization of a Delivery Drone, *MICDE Symposium*, Ann Arbor, MI, Mar 2023.

HONORS AND AWARDS

- Michigan Institute for Computational Discovery and Engineering Fellowship Sep. 2022 – Aug. 2023
- Japan Students Services Organization (JASSO) Graduate Fellowship Sep. 2019 – Aug. 2022
- Outstanding Student Award, JSASS Western Branch Mar. 2019
- Best Student Presentation, JSASS Western Branch Conference 2018 Nov. 2018
- ISTAT Foundation Scholarship Apr. 2018 – Mar. 2019

REVIEWING ACTIVITIES

- Reviewer, *Journal of Air Transportation* Oct. 2022
- Reviewer, *AIAA SciTech Forum* June 2024

OTHER PROFESSIONAL EXPERIENCE

Graduate Student Instructor, University of Michigan Aug. 2023 – Dec. 2023
AE 588: Multidisciplinary Design Optimization

- Graduate-level course on unconstrained and constrained nonlinear optimization for engineering design problems.
- Substitute lecturer in the absence of the primary instructor.
- Led term project setup and management: prepared project topics, provided feedback for proposals, set up starter code using GitHub and Docker, and mentored code implementation and report writing for over 50 students.

Internship at Mitsubishi Heavy Industries, Ltd., Nagoya, Japan Aug. 2017 – Sep. 2017
R&D Center, Strength Research Department

- Investigated and proposed an application of structural health monitoring technology for Mitsubishi SpaceJet aircraft.