Daigo Kobayashi

MyWebsite | LinkedIn | dkobayas@purdue.edu | +1.765.684.2114

Summary

Ph.D. candidate in aerospace engineering with research experience in *computational imaging*, *machine learning*, *Fourier optics*, and *space surveillance*, and solid background in *satellite orbit design*. Collaborated with two national laboratories.

Education

Ph.D. in Aeronautical and Astronautical Engineering 2020 - Present

- Purdue University, West Lafayette, IN
- Major: Astrodynamics and Space Applications
- GPA: 4.00/4.00

Master in Aeronautical and Astronautical Engineering 2018 - 2020

- Purdue University, West Lafayette, IN
- Major: Astrodynamics and Space Applications
- GPA: 3.71/4.00

Bachelor in Mechanical Engineering 2014 - 2018

- Waseda University, Tokyo, Japan
- Major: Mechanical Design and Optimization
- GPA: 3.60/4.00

Publications

[1] Daigo Kobayashi and Carolin Frueh. "Image Recovery of LEO Objects by Leveraging Optical Turbulence and Light Curves". In: *Journal of Guidance, Control, and Dynamics* (Submitted on Apr.2, 2023).

[2] Daniel Galea, Hsi-Yen Ma, Wen-Ying Wu, and Daigo Kobayashi. "Deep Learning Image Segmentation for Atmospheric Rivers". In: *Geoscientific Model Development* (Submitted on June 13, 2023).

[3] Alexander Burton Daigo Kobayashi and Carolin Frueh. "AI-Assisted Near-Field Monocular Monostatic Pose Estimation of Spacecraft". In: *Proceedings of the Advanced Maui Optical and Space Surveillance Technologies Conference*. 2023.

[4] Daigo Kobayashi and Carolin Frueh. "Compressed Sensing for Enhanced Space Security: Resolving Details of Space Objects". In: *CERIAS 24th Security Symposium*. Mar. 2023.

[5] Daigo Kobayashi and Carolin Frueh. "Image-based Satellite Characterization for Low Earth Orbit". In: *33rd AAS/AIAA Space Flight Mechanics Conference*. Jan. 2023.

[6] Daigo Kobayashi and Carolin Frueh. "Reformulating Compressed Sensing to be used with Semi-Resolved Point Spread Function and Light Curves for Space Object Imaging: LEO". In: *Proceedings of the Advanced Maui Optical and Space Surveillance Technologies Conference*. Sept. 2022.

[7] Carolin Frueh, Alex Burton, Daigo Kobayashi, and Liam Robinson. "Space Object Characterization from Light Curves". In: *44th COSPAR Scientific Assembly*. July 2022.

[8] Daigo Kobayashi and Carolin Frueh. "Compressed Sensing for Satellite Characterization: Shadowing as a Sensing Matrix". In: *8th European Conference on Space Debris*. Apr. 2021.

[9] Daigo Kobayashi and Carolin Frueh. "Compressed Sensing for Satellite Characterization: A First Step Using Simulations". In: *43rd COSPAR Scientific Assembly*. Feb. 2021.

[10] Daigo Kobayashi and Carolin Frueh. "Compressed Sensing for Satellite Characterization". In: *AIAA / AAS Astrodynamics Specialist Conference*. Aug. 2020.

Honors

Ito International Education Exchange Awards Fellowship 2018 - 2020

- Receive 90% support of tuition and living cost during two years of Master's program.

Valedictorian at Waseda University March 2018

- Win the Seki Award, being recognized academic excellence.

Tosoh Corporation Scholarship 2016 - 2018

- Receive monthly financial support, being recognized academic excellence.

Projects

Characterization of Space Objects based on Light Curve 2020 - Present

- Recover a resolved image of unknown space object given its time history of unresolved light intensity (light curve) by using compressed sensing.
- Develop an image rendering software on MATLAB that generates synthetic satellite images and light curve intensity based on satellites' geometry, surface properties, and orbit.
- Develop a software to simulate light propagation from space objects under the influence of atmospheric turbulence using the modified von Kármán statistics.

Multi-Vehicle Navigation Project with the Boeing 2023 - Present

- Develop a deep learning algorithm for estimating the attitude of arbitrary space objects.

RAVE Project with the Sandia National Laboratories 2020 - 2021

- Develop a deep learning algorithm to detect and classify airplanes in aerial photographs.
- Achieve a high classification accuracy even with low contrast and partially hidden information.
- Develop a data augmentation algorithm that generates the annotated training dataset, leading to a significant improvement in the classification accuracy.

Waseda-SAT Project at Waseda University in Japan 2017 - 2018

- Build a CAD model of 1U CubeSat consisting of expandable membrane solar cell by SolidWorks.
- Analyze the stiffness, vibration, and thermal characteristics of the model by finite element analysis (FEA) on SolidWorks.

The 13th International Summer School at Samara Univsersity in Russia June 2017

- Win a championship in a CubeSat design competition by prodocing a preliminary design of a satellite for tsunami prediction with a synthetic-aperture radar (SAR).

Academic Service

Reviewed for *Journal of Spacecraft and Rockets* 2021
Reviewed for *The Astrodynamics* 2020

Work Experience

Summer Intern in Physics Team at Lawrence Livermore National Laboratory June - Aug 2023

- Validate LLNL-developed image simulator by matching real data to simulation output.
- Develop physical model for noise backgrounds in infrared imaging.

Summer Intern in Climate Sciences Team at Lawrence Livermore National Laboratory May - Aug 2022

- Debug and produce a user manual for a deep learning code, the Regularized Adversarial Domain Adaptation (RADA) tool, to correct biases of climate models based on adversarial learning.
- Develop a deep learning code to track atmospheric river and extratropical cyclones based on image segmentation algorithm as a part of the E3SM Project.

Technical Trainee at Japan Aerospace Exploration Agency (JAXA) 2017 - 2018

- Evaluate several types of truss modules based on four types of loads: bending, shearing, torsion, and tension by finite element method (FEM).
- Optimize the mass and rigidity of a km-size support truss structure for Space Solar Power System (SSPS) by response surface method on ANSYS.

Teaching Experience

Mentor in Undergraduate Research Program at Purdue University 2020 - 2021

- Developed a research plan to encourage an undergraduate student to gain hands-on research experience.
- Held bi-weekly meetings to discuss research progress and answer the student's questions.

Courses

Astrodynamics and Space Applications

Orbit Mechanics (B) / Advance Orbital Mechanics (audit) / Space Traffic Management (A+) / Advanced Signals and Systems For Satellite Navigation (A) / Optimization in Aerospace Engineering

Autonomy and Control

Spacecraft Attitude Dynamics (A) / Principles of Dynamics (A) / Introduction to Convex Optimization (A) / System Analysis and Synthesis (A) / Introduction to Applied Stochastic Processes (A)

Mathematics and Statistics

Introduction to Probability (B) / Advanced Mathematics for Engineers and Physicists I (A) / Random Variables (A) / Numerical Analysis (A)

Optical Engineering

Diffraction, Fourier Optics, and Imaging (A+) / Optical Imaging System Design (A+)

Software skills

Superb skills in

MATLAB / Python / PyTorch / SolidWorks / Meshlab / GitHub / LaTeX/ Microsoft Office Suite

Familiarity with

Simulink / Julia / C / C++ / Maple / ANSYS / Mathematica / AutoCAD / GMAT / Zemax OpticStudio

Languages

Japanese	Native
English	Professional working proficiency