Jake H. Lee

CONTACT INFORMATION

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RESEARCH INTERESTS

Machine learning and deep learning for Earth and space science. Foundation models and generative AI.

EDUCATION

Columbia University, New York, New York, USA
Department of Computer Science, School of Engineering and Applied Sciences
M.S., Computer Science, May 2020
B.S., Computer Science, May 2019

ACADEMIC EXPERIENCE

Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA

Data Scientist **July 2020 - Current**
Machine Learning and Instrument Autonomy Group. Projects include:
- Onboard science instrument autonomy for a life detection instrument suite concept for Europa and Enceladus (Ocean Worlds Life Surveyor)
- Transformer-based deep learning models for imaging spectroscopy (EMIT, AVIRIS-NG, Carbon Mapper/Tanager)
- Diffusion for unconditional galaxy simulation for weak lensing measurements (Euclid and Roman)
- Science Understanding through Data Science conference steering and organizing committee
- Owner of local LLM service for sensitive, proprietary, and controlled data for JPL missions and institutional pilots

Summer Undergraduate Research Fellow **Summer 2017, 2018, 2019**
Intern under Kiri Wagstaff in the Machine Learning and Instrument Autonomy group. Multi-year research project of explainable ML method to discover novel and interesting images in large data sets.

California Institute of Technology, Pasadena, California, USA

Visiting Lecturer **Winter Quarter 2023**
Invited to teach Prof. Yisong Yue's CS155: Machine Learning and Data Mining course during sabbatical. Managed all assignments, projects, exams, and TAs for 100+ enrolled students.

Columbia University, New York, New York, USA

Graduate Research Student **Fall 2019 - Spring 2020**
Student researcher under Prof. Junfeng Yang at the Software Systems Lab.
Self-directed research quantifying the shift-invariance of image features extracted from CNNs.

Head Teaching Assistant **Spring 2020**
Computational Linear Algebra course taught by Prof. Tony Dear.
Contributed to curriculum and assignment development for a brand new course.
Duties included TA team management, office hours, and biweekly recitations.

Teaching Assistant **Fall 2019**
Artificial Intelligence course taught by Prof. Tony Dear.
Contributed to developing new programming assignments, including autograding on Gradescope.
Duties included grading, office hours, and biweekly recitations.

Research Assistant **Fall 2017 - Spring 2018**
Assistant at the Columbia Plasma Physics Laboratory (HBT-EP).
Integrated and maintained a high-speed camera for visual plasma observations.
Reviewed and optimized Tokamak fusion reactor control programs written in C/CUDA.

Research Assistant **Fall 2016 - Fall 2017**
Assistant at the Lamont-Doherty Earth Observatory Ocean and Climate Physics laboratory.
Analyzed and visualized radiation albedo data from airborne observations of Svalbard.
Integrated and maintained a polarimeter for fieldwork on the R/V Falkor.

Publications

D. Scognamiglio, **J. H. Lee**, E. Huff, S. R. Hildebrandt, S. Hemmati. "Diffusion-based Galaxy Simulations for the Roman High Latitude Survey". *Accepted in The Astrophysical Journal.*

B. D. Bue, **J. H. Lee**, A. K. Thorpe, P. G. Brodrick, D. Cusworth, A. Ayasse, V. Mancoridis, A. Satish, S. Xiong, R. Duren. "Towards Operational Automated Greenhouse Gas Plume Detection". *In review.*

V. Růžička, D. R. Thompson, J. E. Fahlen, A. M. Lopez, S. Lu, C. Xiang, H. Bender, D. Jensen, P. G. Brodrick, **J. H. Lee**, B. D. Bue, D. H. Cusworth, L. Guanter, A. Chlus, A. K. Thorpe, R. O. Green. "Fully Automatic Trace Gas Plume Detection". *In review.*

V. Mancoridis, B. Bue, **J. H. Lee**, A. K. Thorpe, D. Cusworth, A. Ayasse, P. G. Brodrick, R. Duren. "Multi-Platform Methane Plume Detection via Model and Domain Adaptation". *IEEE Transactions on Geoscience and Remote Sensing*, vol. 63, pp. 1-12, 2025.

J. H. Lee, M. Kiper, D. R. Thompson, P. G. Brodrick. "SpecTf: Transformers Enable Data-Driven Imaging Spectroscopy Cloud Detection". *Proceedings of the National Academy of the Sciences of the United States of America*, 122 27, 2025.

D. Scognamiglio, **J. H. Lee**, E. Huff, S. R. Hildebrandt, S. Hemmati. "Denoising Diffusion Probabilistic Model for realistic and fast generated Euclid-like data for weak lensing analysis". *The Astrophysical Journal*, 985 2, 2025.

S. Favrichon, **J. Lee**, Y. Yang, R. Dalagnol, F. Wagner, L. B. Sagang, S. Saatchi. "Monitoring Changes of Forest Height in California". *Frontiers in Remote Sensing*, 5, 2025.

M. Wronkiewicz, **J. Lee**, L. Mandrake, J. Lightholder, G. Doran, S. Mauceri, T. Kim, N. Oborny, T. Schibler, J. Nadeau, J. Wallace, E. Moorjani, C. Lindensmith. "Onboard Science Instrument Autonomy for the Detection of Microscopy Biosignatures on the Ocean Worlds Life Surveyor". *The Planetary Science Journal*, 5 19, 2024.

S. Mauceri, **J. Lee**, M. Wronkiewicz, L. Mandrake, G. Doran, J. Lightholder, Z. Cieslarova, M. Kok, M. F. Mora, A. C. Noell. "Autonomous CE Mass-Spectra Examination (ACME) for the Ocean Worlds Life Surveyor". *Earth and Space Science*, 9, 2022.

F. H. Wagner, R. Dalagnol, A. H. Sánchez, M. C. M. Hirye, S. Favrichon, **J. Lee**, S. Mauceri, Y. Yang, S. Saatchi. "K-textures, a self-supervised hard clustering deep learning algorithm for satellite image segmentation". *Frontiers in Environmental Science*, 10, 2022.

M. Dubay, N. Johnston, M. Wronkiewicz, **J. Lee**, C. Lindensmith, J. Nadeau. "Quantification of Motility in Bacillus subtilis at Temperatures Up to 84°C Using a Submersible Volumetric Microscope and Automated Tracking". *Frontiers in Microbiology*, 13, 2022.

H. Kerner, U. Rebbapragada, K. L. Wagstaff, S. Lu, B. Dubayah, E. Huff, **J. Lee**, V. Raman, S.

Kulshrestha. "Domain-agnostic Outlier Ranking Algorithms (DORA)-A Configurable Pipeline for Facilitating Outlier Detection in Scientific Datasets". *Frontiers in Astronomy and Space Sciences*, 9, 2022.

J. Lee, K. Wagstaff. "Visualizing Image Content to Explain Novel Image Discovery". *Data Mining and Knowledge Discovery*, 34, 1777-1804, 2020.

Conference Presentations

J. Lee, B. D. Bue, P. G. Brodrick, A. K. Thorpe, W. Keely, M. Kiper, J. Fahlen. "Spectral Transformers for EMIT Methane Retrieval". *AGU Fall Meeting*, 2024, #A53I-2209.

B. D. Bue, **J. Lee**, A. K. Thorpe, P. G. Brodrick, D. Cusworth, R. O. Green, R. Duren. "Challenges and Opportunities in Operational Automated Methane Plume Detection". *AGU Fall Meeting*, 2024, #A52C-07.

W. Keely, P. G. Brodrick, A. K. Thorpe, **J. Lee**, J. Fahlen. "Methane emission quantification using diffusion applied to imaging spectroscopy time series for EMIT". *AGU Fall Meeting*, 2024, #A05-07.

M. Kiper, **J. Lee**, P. G. Brodrick, D. R. Thompson. "Spectral Transformers for Earth Science; A Case Study with EMIT Cloud Masking". *AGU Fall Meeting*, 2024, #GC41H-0038.

Y. Sadeh, S. Baber, Y. Ma, O. Oliinyk, L. Leroux, T. Shiferaw, G. Blasch, C. J. Justice, B. Munshell, M. Wronkiewicz, **J. Lee**, D. B. Lobell, I. Becker-Reshef. "Advancing Field-Scale Yield Prediction for Data-Limited Agricultural Regions". *AGU Fall Meeting*, 2024, #GC22E-02.

J. Lee, B. D. Bue, A. K. Thorpe, D. Cusworth, A. Ayasse, R. Duren. "Deep Learning Saliency and Segmentation Methods for Robust Methane Plume Detection". *AGU Fall Meeting*, 2023, #A43R-3011.

P. Brodrick, J. Fahlen, R. W. Coleman, D. R. Thompson, A. K. Thorpe, C. Elder, C. Villanueva-Weeks, A. Lopez, **J. Lee**, B. D. Bue, K. D. Chadwick, R. O. Green. "Algorithm advances for an operational imaging spectroscopy greenhouse gas detection system - lessons from EMIT after a year in orbit". *AGU Fall Meeting*, 2023, #A43R-3009.

V. Mancoridis, B. D. Bue, **J. Lee**, A. K. Thorpe, D. Cusworth, A. Ayasse, R. Duren. "Leveraging Airborne Data to Enable Spaceborne Methane Plume Detection via Model and Data Driven Approaches". *AGU Fall Meeting*, 2023, #A43R-3022.

A. Satish, B. D. Bue, **J. Lee**, A. K. Thorpe, D. Cusworth, A. Ayasse, R. Duren. "Improving Deep Learning Methods for Robust Methane Plume Detection using Alternative Input Representations". *AGU Fall Meeting*, 2023, #A43R-3021.

B. Bue, **J. Lee**, J. Lightholder, A. K. Thorpe, D. Cusworth, A. Ayasse, R. Duren. "Towards Operational Automated Methane Plume Monitoring". *AGU Fall Meeting*, 2023, #A11C-07.

J. Lee, B. Bue, M. Garay, A. Thorpe, R. Duren, D. Cusworth, A. Ayasse. "Robust Multi-Campaign Imaging Spectrometer Methane Plume Detection using Deep Learning". *AGU Fall Meeting*, 2022, #A15L-1395.

J. Lee, S. Favrichon, S. Mauceri, Y. Yang, J. Armston, S. Saatchi. "Addressing Underestimation in Global Forest Structure Mapping". *AGU Fall Meeting*, 2022.

J. Lightholder, M. Wronkiewicz, **J. Lee**, T. Schibler, S. Mauceri, G. Doran, E. Moorjani, C. Lindensmith, L. Mandrake. "Domain-agnostic Outlier Ranking Algorithms (DORA)-A Configurable Pipeline for Facilitating Outlier Detection in Scientific Datasets". *AGU 2021 Fall Meeting*, New

Orleans, LA, 2021.

A. Rao, S. Mauceri, A. Thorpe, **J. Lee**, S. Jongaramrungruang, R. Duren. "Improving Imaging Spectrometer Methane Plume Detection with Large Eddy Simulations". *AGU 2021 Fall Meeting*, New Orleans, LA, 2021.

J. Lee, S. Mauceri, J. Lightholder, M. Wronkiewicz, G. Doran, L. Mandrake, Z. Cieslarova, M. Kok, M. Mora, A. Noell. "Onboard Autonomous Summarization and Prioritization of CE-ESI MS Data for the Ocean Worlds Life Surveyor". *AGU 2021 Fall Meeting*, New Orleans, LA, 2021.

J. Lee, S. Mauceri, S. Dey, A. Rao, R. Alimo, A. Thorpe, S. Jongaramrungruang, R. Duren. "Methane Plume Detection weith Future Orbital Imaging Spectrometers". *AGU 2021 Fall Meeting*, New Orleans, LA, 2021.

D. E. Stillman, K. M. Primm, B. Bue, K. L. Wagstaff, **J. Lee**, A. Ansar. "RSL Geostatistics Show Slopes Above the Angle of Repose and Significant Enhancement After Mars Year 34 Dust Storm". *52nd Lunar and Planetary Science Conference*, Virtual, 2021.

K. Wagstaff, S. Lu, E. Dunkel, K. Grimes, B. Zhao, J. Cai, S. B. Cole, G. Doran, R. Francis, **J. Lee**, L. Mandrake. "Mars Image Content Classification: Three Years of NASA Deployment and Recent Advances". *35th AAAI Conference on Artificial Intelligence*, Virtual, 2021.

P. Horton, S. Ravichandar, **J. Lee**, H. R. Kerner, A. Natha, T. K. Soliman, K. Grimes, K. Wagstaff, R. Verma, J. McAuley. "Novelty and Discovery Content Analysis Methods for the Planetary Data System Image Atlas". *AGU 2020 Fall Meeting*, Virtual, 2020.

J. Lee, J. Yang, Z. Wang. "What Does CNN Shift Invariance Look Like? A Visualization Study". *2020 European Conference on Computer Vision Workshop on Real-World Computer Vision from Inputs with Limited Quality (RLQ-TOD)*, Virtual, 2020.

S. Lu, K. L. Wagstaff, J. Cai, G. Doran, K. Grimes, **J. Lee**, L. Mandrake. "Content-based Classification of Mars Imagery for the PDS Image Atlas". *AGU 2019 Fall Meeting*, San Francisco, CA, 2019.

S. Lu, K. L. Wagstaff, J. Cai, G. Doran, K. Grimes, **J. Lee**, L. Mandrake, Y. Yue. "Improved Content-Based Image Classifiers for the PDS Image Atlas". *4th Planetary Data Workshop*, Flagstaff, AZ, 2019.

K. L. Wagstaff, **J. Lee**. "Interpretable Discovery in Large Image Data Sets". *ICML Workshop on Human Interpretability in Machine Learning*, Stockholm, Sweden, 2018.