Tae Ha (Jeff) **Park**

Ph.D. Candidate, Department of Aeronautics & Astronautics, Stanford University

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Education

Stanford University *Stanford, CA*

Ph.D. in Aeronautics & Astronautics | Advisor: Dr. Simone D'Amico *Apr. 2018 - (Expected) Jun. 2024*

- Title: Robust Machine Learning for Vision-Based Navigation about Non-Cooperative Resident Space Objects
- Teaching Assistant for AA279A: Space Mechanics (2019, 2021, 2022).

Stanford University *Stanford, CA*

M.S. in Aeronautics & Astronautics *Sep. 2017 - Apr. 2020*

- Conducted research on deep learning, computer vision, spacecraft swarm navigation and optimization

Harvey Mudd College (HMC) *Claremont, CA*

B.S. in Engineering *Aug. 2013 - May 2017*

- Graduated with High Distinction (GPA: 3.81/4.0)
- Member of the Tau Beta Pi Engineering Honors Society
- De Pietro fellow in Civil Engineering

Experience

Infinite Orbits SAS *Toulouse, France*

Computer Vision and Guidance, Navigaton and Control Intern *Jun. 2022 - Aug. 2022*

- Constructed a satellite rendezvous simulator and scene renderer based on Unreal Engine 5 and C++ to train and validate convolutional neural networks for monocular pose estimation and tracking of known noncooperative spacecraft

Space Rendezvous Laboratory (SLAB), Stanford University *Stanford, CA*

Research Assistant | Advisor: Dr. Simone D'Amico *Jan. 2019 - Current*

- Developed robust deep learning models and navigation algorithms for vision-based Rendezvous and Proximity Operations (RPO) in space to support various missions (e.g., on-orbit servicing, debris removal) for sustainable space development
- Developed a deep learning model for 3D reconstruction and pose estimation of an unknown spacecraft from single 2D images
- Developed the Testbed for Rendezvous and Optical Navigation (TRON) facility at SLAB that can simulate various RPO scenarios using a mockup satellite model under high-fidelity spaceborne illumination settings
- Developed advanced open-source benchmark datasets (e.g., SPEED+, SHIRT, SPE3R) using synthetic renders such as OpenGL/Unreal Engine and TRON to train and validate spaceborne vision-based deep learning and navigation algorithms with emphasis on robustness across domain gap between synthetic and spaceborne data

Dynamics Laboratory, HMC *Claremont, CA*

De Pietro Fellow | Advisor: Dr. Ziyad Duron *May 2016 - May 2017*

- Developed a method to assess the functionality of steel anchors embedded within a concrete dam based on the Performance-Based Testing using spectral analysis, spectrogram, and model verification
- Analyzed the earthquake response of Monticello dam by constructing and evaluating a lumped element model of dam, reservoir and a spillway

HMC *Claremont, CA*

Student Researcher | Advisor: Dr. Philip D. Cha *May 2016 - May 2017*

- Developed a method to accelerate the modal convergence of eigen-characteristics of (non-)uniform rods carrying various lumped attachments

Publications

Peer-Reviewed Journal Articles

[J6] Adaptive Neural-Network-Based Unscented Kalman Filter for Robust Pose Tracking of Noncooperative Spacecraft
T. H. Park, S. D'Amico
Journal of Guidance, Control, and Dynamics (2023). DOI: 10.2514/1.G007387

[J5] Robust Multi-Task Learning and Online Refinement for Spacecraft Pose Estimation across Domain Gap
T. H. Park, S. D'Amico
Advances in Space Research (2023). DOI: 10.1016/j.asr.2023.03.036

[J4] Leveraging Neural Network Uncertainty in Adaptive Unscented Kalman Filter for Spacecraft Pose Estimation
L. Pasqualetto Cassinis, **T. H. Park**, N. Stacey et al.
Advances in Space Research (2023). DOI: 10.1016/j.asr.2023.02.021

[J3] Satellite Pose Estimation Competition 2021: Results and Analyses
T. H. Park, M. Märtens, M. Jawaid et al.
Acta Astronautica (2023). DOI: 10.1016/j.actaastro.2023.01.002

[J2] Satellite Pose Estimation Challenge: Dataset, Competition Design and Results
M. Kisantal, S. Sharma, **T. H. Park** et al.
IEEE Transactions on Aerospace and Electronic Systems (2020). DOI: 10.1109/TAES.2020.2989063

[J1] Improved Modal Convergence Using the Assumed Modes Method for Rods Carrying Various Lumped Elements
P. D. Cha, **T. H. Park**
International Journal of Mechanical Engineering Education (2018). DOI: 10.1177/0306419017720424

Conference Proceedings & Presentations

[C10] Online Supervised Training of Spaceborne Vision during Proximity Operations using Adaptive Kalman Filtering
T. H. Park, S. D'Amico
2024 IEEE International Conference on Robotics and Automation (ICRA), Yokohama, Japan (2024). **[Accepted]**

[C9] SPEED-UE-Cube: A Machine Learning Dataset for Autonomous, Vision-Based Spacecraft Navigation
Z. Ahmed, **T. H. Park**, A. Bhattacharjee et al.
46th AAS Guidance, Navigation and Control Conference, Breckenridge, Colorado, February 2-7 (2024). **[Accepted]**

[C8] Rapid Abstraction of Spacecraft 3D Structure from Single 2D Image
T. H. Park, S. D'Amico
2024 AIAA SciTech Forum (2024). DOI: 10.2514/6.2024-2768

[C7] Adaptive End-to-End Architecture for Autonomous Spacecraft Navigation and Control During Rendezvous and Proximity Operations
J. Kruger, T. Guffanti, **T. H. Park** et al.
34th AIAA/AAS Space Flight Mechanics Meeting (2024). DOI: 10.2514/6.2024-0430

[C6] Adaptive Neural Network-based Unscented Kalman Filter for Spacecraft Pose Tracking at Rendezvous
T. H. Park, S. D'Amico
2022 AAS/AIAA Astrodynamics Specialist Conference, Charlotte, North Carolina, August 7-11 (2022).

[C5] Robust Multi-Task Learning and Online Refinement for Spacecraft Pose Estimation across Domain Gap
T. H. Park, S. D'Amico
11th International Workshop on Satellite Constellations & Formation Flying, Milano, Italy, June 7-10 (2022).

[C4] SPEED+: Next-Generation Dataset for Spacecraft Pose Estimation across Domain Gap
T. H. Park, M. Märtens, G. Lecuyer et al.
2022 IEEE Aerospace Conference (2022). DOI: 10.1109/AERO53065.2022.9843439

[C3] Robotic Testbed for Rendezvous and Optical Navigation: Multi-Source Calibration and Machine Learning Use Cases
T. H. Park, J. Bosse, S. D'Amico
2021 AAS/AIAA Astrodynamics Specialist Conference, Virtual, August 8 - 12 (2021).

[C2] Generative Model for Spacecraft Image Synthesis using Limited Dataset
T. H. Park, S. D'Amico
2020 AAS/AIAA Astrodynamics Specialist Conference, South Lake Tahoe, California, August 9 - 13 (2020).

[C1] Towards Robust Learning-Based Pose Estimation of Noncooperative Spacecraft
T. H. Park, S. Sharma, S. D'Amico
2019 AAS/AIAA Astrodynamics Specialist Conference, Portland, Maine, August 11 - 15 (2019). **<Best Paper Award>**

Open-Source Datasets

[D5] Spacecraft Pose Estimation Dataset of a 3U CubeSat using Unreal Engine (SPEED-UE-Cube)
T. H. Park, Z. Ahmed, A. Bhattacharjee et al.
Stanford Digital Repository (2024).

[D4] SPE3R: Synthetic Dataset for Satellite Pose Estimation and 3D Reconstruction
T. H. Park, S. D'Amico
Stanford Digital Repository (2024). DOI: 10.25740/pk719hm4806

[D3] SHIRT: Satellite Hardware-In-the-loop Rendezvous Trajectories Dataset
T. H. Park, S. D'Amico
Stanford Digital Repository (2022). DOI: 10.25740/zq716br5462

[D2] Next Generation Spacecraft Pose Estimation Dataset (SPEED+)
T. H. Park, M. Märtens, G. Lecuyer et al.
Stanford Digital Repository (2021). DOI: 10.25740/wv398fc4383

[D1] Spacecraft Pose Estimation Dataset (SPEED)
S. Sharma, **T. H. Park**, S. D'Amico
Stanford Digital Repository (2019). DOI: 10.25740/dz692fn7184

Activities

Co-organizer Kelvins Satellite Pose Estimation Competition (2021), AI4Space (CVPR workshop) (2024)

Reviewer Journal of Spacecraft and Rockets (2020), Journal of Aerospace Information Systems (2021 - 22), Advances in Space Research (2022-23), IEEE Transactions on Aerospace and Electronic Systems (2022 - 23), Journal of Guidance, Control, Dynamics (2023)

Skills

Programming MATLAB/Simulink, Python, C/C++, CUDA, LaTeX
Deep Learning PyTorch (Python & C++), ONNXRuntime, TensorRT, MATLAB Deep Learning Toolbox™
Libraries OpenCV, PyTorch3D, OpenMP, CVX/CVXPY
Rendering OpenGL, Unreal Engine
Languages Korean (native), English (fluent), Japanese (proficient), French (conversational)

Honors & Awards

2019 **Best Paper Award**, 2019 AAS/AIAA Astrodynamics Specialist Conference *Portland, ME*
2015 **Tau Beta Pi Engineering Honors Society**, HMC *Claremont, CA*
2015 **De Pietro Fellowship in Civil Engineering**, HMC *Claremont, CA*
2013 **Harvey S. Mudd Merits**, HMC *Claremont, CA*
2013-17 **Dean's List**, HMC *Claremont, CA*