

# Patrick Rim

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## Research Interests

Computer vision, generative models, representation learning, AI for science

## Education

### California Institute of Technology

2020 – 2024

B.S. in Computer Science, Minor in Information and Data Sciences

**GPA: 4.3/4.3** (Ranked #1 in Computer Science)

## Research Experience

### MSC Lab, UC Berkeley

Advisor: Dr. Wei Zhan

Aug 2022 – Present

- Improve 3D point-cloud segmentation mIOU by 2% using denoising pretraining. Build diffusion model for joint 3D segmentation and detection.
- Fuse and transfer information between sparse representations of LiDAR and camera inputs to achieve state-of-the-art 3D object detection.
- Create novel representation of 3D scenes using quadric representations to improve accuracy and efficiency of odometry, mapping, and localization.
- Two papers published in *ICCV 2023* and *RA-L*.

### Yue Lab, Caltech

Advisor: Prof. Yisong Yue

May 2022 – Present

- Build and train diffusion models for conditional trajectory generation.
- Learn animal behaviors in an unsupervised manner by clustering latent representation space of classifier predicting interaction type.
- Develop an unsupervised contrastive learning method to learn and disentangle causal features from spurious correlations.
- Create interpretable labels of beetle behavior using A\*-NEAR search and a domain-specific language.

### Alvarez Lab, Caltech

Advisors: Prof. Mike Alvarez, Prof. Christina Ramirez

Oct 2021 – Present

- Develop a novel transformer-based vision architecture to outperform state-of-the-art methods in image sentiment analysis, and use it to identify emotions in political ad videos.
- Explore deep learning approaches for detecting HIV using genetic data.
- Build a mixed-effects fuzzy forest architecture to analyze longitudinal and highly correlated high-dimensional time-series data.

### **“CaltechFN: Distorted and Partially Occluded Digits” Project**

Advisors: Dr. Elijah Cole, Prof. Yisong Yue

Sep 2021 – Dec 2022

- Led project to create the CaltechFN dataset as the new state-of-the-art benchmark for classification, detection, and weakly-supervised detection.
- Provided experimental accuracy and mAP results showing vision models trained on CaltechFN exhibit improved performance and generalize well across datasets.
- First-authored paper published in *ACCV 2022*.

### **Niels Bohr Institute, University of Copenhagen**

Advisor: Prof. Charles Steinhardt

June 2021 – Jan 2022

- Implemented various dimensionality reduction algorithms to identify a new class of galaxies in the COSMOS dataset.
- Discovered that my results suggest a new regime of galaxy evolution; finalizing a paper for publication.
- Paper published in *CURJ 2022* (undergraduate research journal).

### **Parker Lab and Sternberg Lab, Caltech**

Advisors: Prof. Joe Parker, Prof. Paul Sternberg

Dec 2020 – Nov 2021

- Explored deep learning approaches for classifying beetle behaviors given time-series keypoint data.
- Integrated single-cell RNA sequencing data across different batches of data by removing batch effects and retaining variability across the data.

### **Department of Computer Science, CSUF**

Advisor: Prof. Shawn X. Wang

May 2020 – Dec 2020

- Created an optimization of the C4.5 decision tree ML algorithm that improves accuracy by 5.11% and decreases runtime by 46.38%.
- First-authored paper published in *IJACSA*.

### **Department of Physics and Astronomy, USC**

Advisor: Prof. Elena Pierpaoli

May 2019 – Aug 2019

- Validated galaxy clusters in the Planck SZ2 microwave-wavelength dataset by using clustering algorithms to discover their optical counterparts.
- Paper published in *New Astronomy*.

## Publications

### **SparseFusion: Fusing Multi-Modal Sparse Representations for Multi-Sensor 3D Object Detection**

Y. Xie, C. Xu, M. Rakotosaona, **P. Rim**, F. Tombari, K. Keutzer, M. Tomizuka, W. Zhan.

*International Conference on Computer Vision (ICCV)*, 2023.

### **Quadric Representations for LiDAR Odometry, Mapping and Localization**

C. Xia, C. Xu, **P. Rim**, M. Ding, N. Zheng, K. Keutzer, M. Tomizuka, W. Zhan.

*IEEE Robotics and Automation Letters (RA-L)*, 2023.

### **CaltechFN: Distorted and Partially Occluded Digits**

**P. Rim**, S. Saha, M. Rim.

*Asian Conference on Computer Vision (ACCV)*, 2022.

### **Optimizing the C4.5 Decision Tree Algorithm using MSD-Splitting**

**P. Rim**, E. Liu.

*International Journal of Advanced Computer Science and Applications*, 2020.

### **Validating Planck SZ2 Clusters with Optical Counterparts**

P. Banerjee, E. Pierpoali, N. Mirzatury, K. Maamari, **P. Rim**.

*New Astronomy*, 2019.

### **Dimensionality Reduction as Evidence of a New Regime of Galaxies**

**P. Rim**, C. Steinhardt, A. Blank.

*Caltech Undergraduate Research Journal (CURJ)*, 2022.

## Teaching Experience

### **Head Instructor (CS 12: Computer Vision for Research)      2022 – 2023**

- Independently designed and taught a term-long course that provides students with a practical and theoretical foundation in computer vision.
- Covered fundamental topics and advanced topics such as generative modeling and 3D vision, drawing from my own research.
- Taught 23 total students, including undergraduate and graduate students.<sup>1</sup>
- Planning to teach updated course covering diffusion models in 2024.

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<sup>1</sup>Selected student endorsements:

- “I think you have made excellent video lectures and you are very good at explaining subjects clearly and concisely.”
- “The lectures have been very comprehensive and helpful. Thanks for designing a great course!”

	<b>Head TA (Freshman Summer Research Institute)</b>	Summer 2022
	<ul style="list-style-type: none"> <li>• Collaboratively designed a research project for FSRI (First-Year Success Research Institute) at Caltech, a DEI (Diversity, Equity, and Inclusion) program. Work included creating mini-projects and providing in-person help to students for 4-6 hours a week.</li> <li>• Developed machine learning curriculum and assisted students with incorporating computer vision into their robotics projects.</li> </ul>	
	<b>Head of Online, TA (CS 2, CS 3, CS 24)</b>	2021 – 2023
	<ul style="list-style-type: none"> <li>• Worked as TA for CS 2 (Data Structures), CS 3 (Software Design), and CS 24 (Systems) under Professor Adam Blank in the fall, winter, and spring terms respectively.</li> <li>• Promoted to Head of Online (Ticketing) role, where I was in charge of managing a 24/7 online help platform, in addition to holding 4 hours of Office Hours per week.</li> </ul>	
Honors and Awards	Henry Ford II Scholar Award	2023
	Jack E. Froehlich Memorial Award Nominee	2023
	Marcella Bonsall SURF Fellowship	2022
	George W. Housner Fund Recipient	2021, 2022
	William Hassenzahl Family SURF Fellowship	2021
	Hixon Prize for Writing Nominee	2021
	1st Place, AI Hacks Hackathon at UPenn	2020
	Top 5 Overall Hack, YHack at Yale	2020
	“Best Use of Google Cloud” Award	2020
	“Facebook: Building Community” Award	2020
	National Merit Scholarship Recipient	2020
Service and Leadership	<b>NeurIPS 2023 Datasets &amp; Benchmarks Track</b> , Reviewer	2023
	<b>NeurIPS 2022 Datasets &amp; Benchmarks Track</b> , Reviewer	2022
	<b>Deans Office Tutoring Program</b> , Tutor	2022 – Present
	<b>Quantitative Finance Club</b> , Head of ML Research	2022 – Present
	<b>Course Ombuds Program</b> , Ompudsperson	2020 – 2022
Industry Experience	<b>Squarepoint Capital</b> , Quantitative Research Intern	Summer 2023
	<ul style="list-style-type: none"> <li>• Analyzed and created database of U.S. natural gas and power futures price, volatility, and volume data.</li> <li>• Performed market structure analysis to find predictive factors using statistical and deep learning methods.</li> </ul>	

	<b>Airstrafe Interactive</b> , Software Engineering Intern	Spring 2023
	<ul style="list-style-type: none"> <li>• Designed and integrated dynamic probability models to build new AI and logic systems using C# and Unity.</li> <li>• Created inverse kinematics system using quaternions and 3D math for realistic movement and rotation.</li> </ul>	
Talks and Presentations	<b>Efficient 3D Vision</b>	Mar 2023
	Berkeley Artificial Intelligence Labs	
	<b>CaltechFN: Distorted and Partially Occluded Digits</b>	Dec 2022
	Oral Presentation at ACCV 2022	
	<b>Sentiment Analysis of Political Ad Videos</b>	Oct 2022
	Caltech SFP Fall Seminar Day	
	<b>Identifying the Pre-Main Sequence with t-SNE</b>	Jun 2022
	Poster at 240th Meeting of the American Astronomical Society	
	<b>Dimensionality Reduction to Find a New Galaxy Regime</b>	Oct 2021
	Caltech SFP Fall Seminar Day	
	<b>Rethinking Galaxy Evolution with Unsupervised Learning</b>	Aug 2021
	Technical University of Denmark	