

Renan A. Rojas-Gomez

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Education

Ph.D. Candidate in Electrical and Computer Engineering <i>Computational Imaging Group, University of Illinois at Urbana-Champaign</i> Advisor: Prof. Minh N. Do.	Illinois, USA 2018 - Present
M.Sc. in Digital Signal and Image Processing <i>Pontifical Catholic University of Peru</i>	Lima, Peru 2010 - 2011
B.Sc. in Electrical Engineering <i>Pontifical Catholic University of Peru</i>	Lima, Peru 2003 - 2008

Research Interests

Deep learning, computer vision, signal and image processing.

Programming Skills

PyTorch, TensorFlow, Python, MATLAB, LINUX.

Research Experience

Student Researcher, Google DeepMind <i>Enhancing Spatial Reasoning in Large Language Models</i>	California, USA 05/2024 - 08/2024
<ul style="list-style-type: none">■ Evaluated the performance of Large Language Models on questions involving spatial reasoning.■ Developed an auto-regressive scene representation technique to improve Large Language Model Q/A accuracy.	
Research Assistant, University of Illinois at Urbana-Champaign (UIUC) <i>Multivariate radiomics and omics data integration</i>	Illinois, USA 02/2024 - 05/2024
<ul style="list-style-type: none">■ Studied state-of-the-art semantic segmentation methods for anatomy-scale and tissue-scale analyses.■ Benchmarked Large Visual Models for organ semantic segmentation via zero-shot prompting.■ Evaluated the use of deep image alignment methods for modality-agnostic organ semantic segmentation.	
Student Researcher, Google Research <i>Semantic-aware data augmentation for self-supervised learning via neural style transfer</i>	California, USA 9/2023 - 12/2023
<ul style="list-style-type: none">■ Continuation of the previous summer internship project.■ Improved few-shot image classification performance compared to traditional augmentation methods.■ Improved downstream task performance on self-supervised learning methods using larger representation models, including vision transformers.■ Investigated how using different content and style datasets affects the downstream task performance.	
Research Intern, Google Research <i>Semantic-aware data augmentation for self-supervised learning via neural style transfer</i>	California, USA 05/2023 - 8/2023

- Developed a novel semantic-aware data augmentation technique for self-supervised learning using neural style transfer, improving representation learning in established techniques like SimCLR, BYOL, and MoCo.
- Improved downstream classification performance accuracy compared to traditional augmentation methods.
- Demonstrated significant transfer learning performance improvement across various datasets.

Research Assistant, University of Illinois at Urbana-Champaign **Illinois, USA**
Cell classification via coherent Raman microscopy and multiphoton imaging 02/2022 - 05/2023

- Designed a semi-supervised machine learning algorithm to classify cells based on their Self-amplifying mRNA (SAM) vaccine uptake.
- Combined multiphoton and hyperspectral imaging to study the spatial distribution and functional activity of vaccine uptake and expression.
- Enhanced cell classification under different uptake conditions by leveraging hyperspectral image features.

Machine Learning Research Intern, Robert Bosch LLC **Pennsylvania, USA**
One-shot traffic sign classification via deep learning color quantization 05/2021 - 08/2021

- Developed a deep learning color quantization method for traffic sign classification and recognition tasks.
- Improved one-shot classification via integration with metric learning methods and VAEs.
- Published US patent.

Research Assistant, University of Illinois at Urbana-Champaign **Illinois, USA**
Wavelet-based photorealistic style transfer for colorization of indoor environments 01/2019 - 06/2021

- Developed a novel wavelet-based photorealistic style transfer algorithm.
- Implemented a highly efficient stylization method matching the performance of neural approaches while significantly reducing the computational burden.
- Developed an interactive web-based scene colorization tool for commercial applications.

Research Intern, Los Alamos National Laboratory (LANL) **New Mexico, USA**
Physics-consistent data-driven waveform inversion with adaptive data augmentation 06/2019 - 08/2019

- Developed a novel deep learning method for seismic full-waveform inversion, enabling high-resolution estimation of geophysical velocity models.
- Proposed a physics-informed data augmentation technique that injects realistic seismic variations into the training samples, improving transfer learning performance.
- Achieved superior accuracy in recovering the subsurface elastic parameters compared to established approaches.

Visiting Scholar, Harvard University **Massachusetts, USA**
School of Engineering and Applied Sciences 01/2018 - 03/2018

- Project: Efficient Quanta Image Sensor Reconstruction Algorithms.
- Funded by the UTEC-Harvard Academic Collaboration Fund 2015-03.

Visiting Scholar, University of Rochester **New York, USA**
Sonoelasticity Imaging Laboratory 01/2015 - 03/2015

- Project: Nonstationary signal modeling and ultrasound image analysis for breast cancer detection.
- Funded by Peruvian Grant 205-FINCyT-IA-2013.

Summer Intern, Los Alamos National Laboratory **New Mexico, USA**
T5: Applied Mathematics and Plasma Physics 06/2011 - 08/2011

- Project: Efficient Total Variation Mixed Noise Image Restoration Techniques.
- Funded by Peruvian Grant 179-FINCyT-IB-2013.

Research Assistant, Pontifical Catholic University of Peru (PUCP) **Lima, Peru**
Electrical Engineering Section 2010 - 2014

- Developed an AM-FM based nonstationary signal modeling algorithm for sonoelasticity imaging.
- Collaborated on a GPU-based video stabilization algorithm for real-time traffic analysis.

Teaching Experience

Lecturer, University of Engineering and Technology (UTEC)

Electrical Engineering Department

Lima, Peru

2014 - 2018

- EL5002: Signals and Systems (7 semesters).

Lecturer, Pontifical Catholic University of Peru

Electrical Engineering Section and Graduate School

Lima, Peru

2012 - 2018

- IEE239: Digital Signal and Image Processing (8 semesters).
- IEE144: Logic Design (2 semesters).
- MTR608: Computer Vision (1 semester).
- ING607: Research Tools Seminar (1 semester).
- MAT787: Optimization Theory (1 semester).
- IEE146: Logic Design Laboratory (8 semesters).

Industry Experience

Project Engineer, Refineria La Pampilla, Repsol (*Petroleum Refining Company*)

Engineering and Maintenance Department

Lima, Peru

2008

- Selection of ultrasonic-based flux measurement instruments.
- Design of piping and instrumentation diagrams.
- Maintenance of power and control circuits.

Scholarships and Awards

- Rampus Computer Engineering Fellowship (UIUC), 2024-25.
- Thomas and Margaret Huang Award for Graduate Research (UIUC), 2023-24.
- Dan Vivoli Endowed Fellowship (UIUC), awarded three times: 2020-21, 2022-23, 2023-24.
- Mavis Future Faculty Fellowship (UIUC), 2021-22.
- J. William Fulbright Fellowship, 2018-19.
- IEEE International Conference on Image Processing (ICIP) Travel Grant, 2017.
- University of Engineering and Technology (UTEC) Travel Grant, 2017.
- Research Funding for Graduate Students Award (PUCP), 2011.
- Master Program Fellowship (PUCP), 2010-11.

Publications

Under Submission

- [1] Warren Morningstar, Alex Bijamov, Chris Duvarney, Luke Friedman, Neha Kalibhat, Luyang Liu, Philip Mansfield, Renan Rojas-Gomez, Karan Singhal, Bradley Green, et al. Augmentations vs algorithms: What works in self-supervised learning. *28th International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2025.
- [2] Renan A Rojas-Gomez and Minh N Do. Gist: Towards photorealistic style transfer via multiscale geometric representations. *IEEE Transactions on Image Processing*, 2024.

Conference Articles

- [3] R. Rojas-Gomez, K. Singhal, A. Etemad, A. Bijamov, W. Morningstar, and P. Mansfield. Sssl: Leveraging neural style transfer for improved self-supervised learning. In *ECCV Workshop on Self Supervised Learning: What is Next?*, 2024.

- [4] R. Rojas-Gomez, T. Lim, M. Do, and R. Yeh. Making vision transformers truly shift-equivariant. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2024.
- [5] R. Rojas-Gómez, T. Lim, M. Do, A. Schwing, and R. Yeh. Learnable polyphase sampling for shift invariant and equivariant convolutional networks. In *Advances in Neural Information Processing Systems (NeurIPS)*, volume 36, 2022.
- [6] R. Rojas-Gómez, R. Yeh, M. Do, and A. Nguyen. Inverting adversarially robust networks for image synthesis. In *16th Asian Conference on Computer Vision (ACCV)*, 2022.
- [7] R. Rojas-Gómez, J. Yang, Y. Lin, J. Theiler, and B. Wohlberg. Physics-Consistent Data-driven Seismic Inversion with Adaptive Data Augmentation. In *NeurIPS Workshop on Machine Learning and the Physical Sciences*, 2020.
- [8] R. Rojas, W. Luo, V. Murray, and Y. Lu. Learning optimal parameters for binary sensing image reconstruction algorithms. In *Conference on Image Processing (ICIP), 2017 IEEE International*, Beijing, China, 2017.
- [9] R. Rojas, J. Ormachea, K.J. Parker, and B. Castaneda. Shear wave estimation using null space pursuit and AM-FM demodulation. In *Ultrasonics Symposium (IUS), 2015 IEEE International*, pages 1–4, 2015. DOI: 10.1109/ULTSYM.2015.0378.
- [10] J. Ormachea, R. Rojas, P. Rodriguez, R. Lavarello, K. Parker, and B. Castaneda. Shear Wave Speed Estimation from Crawling Wave Sonoelastography: A comparison between AM-FM Dominant Component Analysis and Phase Derivation Methods. In *Ultrasonics Symposium (IUS), 2014 IEEE International*, pages 2327–2330. IEEE, 2014. DOI: 10.1109/ULTSYM.2014.0580.
- [11] R. Rojas, J. Ormachea, A. Salo, P. Rodríguez, A. Lerner, and B. Castaneda. Crawling Waves Speed Estimation Based on Dominant Component Analysis AM-FM Demodulation. In *Twelfth International Tissue Elasticity Conference*, Lingfield, UK, 2013.
- [12] P. Rodríguez, R. Rojas, and B. Wohlberg. Mixed Gaussian-Impulse Noise Image Restoration Via Total Variation. In *IEEE International Conference on Acoustics, Speech, and Signal Processing*, pages 1077–1080, Kyoto, Japan, 2012. DOI: 10.1109/ICASSP.2012.6288073.
- [13] R. Rojas and P. Rodríguez. Spatially Adaptive Total Variation Image Denoising Under Salt and Pepper Noise. In *European Signal Processing Conference*, pages 278–282, Barcelona, Spain, 2011. ISSN: 2076-1465.

Journal Articles

- [14] R. Rojas-Gomez, K. Singhal, A. Etemad, A. Bijamov, W. Morningstar, and P. Mansfield. Sssl: Enhancing self-supervised learning via neural style transfer. *Transactions on Machine Learning Research (TMLR)*, 2024.
- [15] R. Rojas-Gomez, K. Bera, P. Mukherjee, C. Snyder, E. Aksamitiene, A. Alex, D. Spillman, M. Marjanovic, A. Shabana, R. Johnson, S. Hood, and S. Boppart. Probing delivery of a lipid nanoparticle encapsulated self-amplifying mrna vaccine using coherent raman microscopy and multiphoton imaging. *Nature Scientific Reports*, 2024.
- [16] R. Rojas-Gómez, J. Yang, Y. Lin, J. Theiler, and B. Wohlberg. Physics-consistent data-driven waveform inversion with adaptive data augmentation. *IEEE Geoscience and Remote Sensing Letters*, pages 1–5, 2020. DOI: 10.1109/LGRS.2020.3022021.
- [17] R. Rojas, J. Ormachea, A. Salo, P. Rodríguez, K. Parker, and B. Castaneda. Crawling Waves Speed Estimation Based on the Dominant Component Analysis Paradigm. *Ultrasonic imaging*, 2015. DOI: 10.1177/0161734614568651.

Patents

- [18] Mohammad Sadegh Norouzzadeh, Renan Alfredo Rojas-Gomez, Anh Nguyen, and Filipe J Cabrita Condessa. Image quantization using machine learning, June 15 2023. US Patent App. 17/546,391.