

Renán A. Rojas-Gómez

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Education

Ph.D. Candidate in Electrical and Computer Engineering

Computational Imaging Group, University of Illinois at Urbana-Champaign

Advisor: Prof. Minh N. Do.

Illinois, USA

2018 - Present

M.Sc. in Digital Signal and Image Processing

Pontifical Catholic University of Peru

Thesis: Automatic Regularization Parameter Selection for Total Variation Image Restoration.

Lima, Peru

2010 - 2011

B.Sc. in Electrical Engineering

Pontifical Catholic University of Peru

Thesis: Efficient Image Alignment for Precision Farming Applications.

Lima, Peru

2003 - 2008

Research Interests

Deep learning, computer vision, signal and image processing.

Programming Skills

PyTorch, TensorFlow, Python, MATLAB, LINUX.

Research Experience

Research Intern, Google

Semantic-aware data augmentation for self-supervised learning via neural style transfer

California, USA

05/2023 - 12/2023

- 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 (UIUC)

Cell classification via coherent Raman microscopy and multiphoton imaging

Illinois, USA

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.

Research Intern, Bosch Center for Artificial Intelligence

One-shot traffic sign classification via deep learning color quantization

Pennsylvania, USA

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)

Lima, Peru

Electrical Engineering Department

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).

Thesis Advising:

- Stefanni E. Corrales, "Reconocimiento de actividades humanas mediante una cámara usando procesamiento de imágenes con aplicaciones en seguridad ciudadana," B.Sc. thesis, 2015.
- Alberto H. Inafuku, "Diseño de un algoritmo de estabilización de video orientado a la detección de personas," B.Sc. thesis, 2015.

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.

Publications

Under Submission

- [1] R. Rojas-Gomez, K. Singhal, A. Etemad, A. Bijamov, W. Morningstar, and P. Mansfield. Sssl: Enhancing self-supervised learning via neural style transfer. In *The 41st International Conference on Machine Learning (ICML)*, 2024.

Conference Articles

- [2] 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.
- [3] 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.
- [4] 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.
- [5] 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.

- [6] 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.
- [7] 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.
- [8] 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.
- [9] 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.
- [10] 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.
- [11] 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

- [12] 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.
- [13] 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.
- [14] 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.

Patents

- [15] 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.

Scholarships and Awards

- Rambus 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.