DIEGO PATIÑO

POST-DOCTORAL RESEARCHER

Geometric Computer Vision and Machine Learning

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RESEARCH SUMMARY

My academic interests include machine learning, physics-informed neural networks, and geometric approaches to computer vision, focusing on 3D vision, shape analysis, symmetry detection, and single-image to 3D Reconstruction. In my research, I explore relevant mathematical concepts such as epipolar geometry, differential geometry, equivariance, deep learning, and graph neural networks to solve fundamental problems in computer vision and engineering. My work has applications on multi-disciplinary fields such as medical imaging, robotics, 3D motion prediction, and 3D reconstruction.

EDUCATION

2014 - 2020 **National University of Colombia - Medellin, Colombia**
Ph.D. in Computer Engineering
Advisor: **John W. Branch**
Dissertation: "Shape Analysis and Description Based on the Isometric Invariances of Topological Skeletonization."

2010 - 2012 **National University of Colombia - Medellin, Colombia**
M.Sc. in Computer Engineering
Advisor: **John W. Branch**
Thesis: "Automatic landform classification using texture analysis on satellite images."

2005 - 2010 **National University of Colombia - Medellin, Colombia**
B.S.E. in Computer Engineering

RESEARCH EXPERIENCE

2020 - Present **Post-Doctoral Researcher**
University of Pennsylvania
GRASP Lab - General Robotics, Automation, Sensing & Perception Lab

- *Lead independent research on **machine learning and geometric computer vision**.*
- *Investigated graph **neural network-based control for Aerial Unmanned vehicles** navigating in turbulence wind fields.*
- *Developed a novel deep learning-based method for **3D reconstruction** from single-image or point clouds.*
- *Developed novel **geometry-based pose features** for imitation deficiency in subjects with **Autistic Spectrum Disorder (ASD)**, in collaboration with Philadelphia's Children Hospital.*
- *Mentored and supervised research for multiple Ph.D. and Master students.*
- *Coordinated and secured guest speakers for weekly team meetings, to discuss the **latest state-of-the-art advances in computer vision**.*
- *Worked under the supervision of **Prof. Kostas Daniilidis**.*

2018 - 2020 **Visiting Researcher**
University of Pennsylvania
GRASP Lab - General Robotics, Automation, Sensing & Perception Lab

- *Conducted research on deep learning and geometric computer vision.*
- *Developed computer vision tools for **symmetry detection in 3D objects**.*
- *Worked under the supervision of **Prof. Kostas Daniilidis**.*

2014 - 2015 **Research Assistant**
University of Wisconsin-Madison
Laboratory for Molecular and Computational Genomics

- *Conducted research to develop new computer vision approaches for **detecting, sequencing, and aligning single DNA molecules under confinement**. I worked under the supervision of **Prof. David C. Schwartz**.*

2012 - 2012 **Research Assistant**
Pontifical Catholic University of Chile
Department of Computer Science

- *Created feature extraction, selection, and classification methods for **computer vision-based automatic quality inspection**. I worked under the supervision of **Prof. Domingo Mery**.*

2008 - 2011 **Research Assistant**
National University of Colombia
Department of Geo-science and Water Resources

- *Developed **computer vision tools** applied to geo-spatial information and automatic classification of landforms.*

INDUSTRY EXPERIENCE

2016 - 2018 **Software Developer**
Gotta Ingenieria
https://gottaingenieria.com

- *Designed and developed several **python-based hydro-morphology simulation** plug-ins for the ArcGIS platform.*

2016 - 2016 **Software Developer**
Launchpad
https://www.launchpadapps.com.au

- *Designed and developed client/server apps for the iOS platform in **Objective C and Swift** programming languages.*

2012 - 2014 **Software Engineer**
Early Warning System of the City of Medellín
https://siata.gov.co

- *Developed software to support **geo-spatial data visualization** for weather forecasting.*
- *Implemented **computer vision tools** to process images generated from Doppler microwave weather radars.*

TEACHING EXPERIENCE

- **Algorithms** (Teaching assistant). Fall 2010 - Fall 2011.
- **Databases**. Spring 2011.
- **Introduction to Programming**. Spring 2013.
- **Web Development**. Spring 2013.
- **Physics Simulations and Software Engineering for Instrumentation**. Fall 2013.
- **Algorithms**. Fall 2016.
- **Computer Vision**. Fall 2017.

SKILLS

Python/Numpy/SciPy	9+ yrs	**Matlab**	5+ yrs
Pytorch/Tensorflow/Jax/OpenCV	4+ yrs	**Java**	3+ yrs
Git/CSV/SVN	8+ yrs	**C++/CUDA**	3+ yrs
Linux/Unix	16+ yrs	**Scientific writing/LaTeX**	12+ yrs
Slurm/Docker/Kubernets	5+ yrs		

LANGUAGES

- **Spanish** Native
- **English** Fluent
- **Portuguese** Good

HONORS AND AWARDS

- MinCiencias Doctoral Scholarship, Colombia, 2015.
- Enlazamundos Scholarship, Medellín - Colombia, 2012.
- Full Tuition Fellowship Award (Masters program), Faculty of Mines, National University of Colombia, 2012.

REVIEWER

Journals

- **IEEE Transactions on Medical Imaging.**
- **Elsevier's Pattern Recognition Journal.**
- **Canadian Journal of Forest Research.**
- **Revista DYNA.** Engineering journal edited by the National University of Colombia.

Conferences

- **ICPR'22 Reviewer.** 26th International Conference on Pattern Recognition.
- **MICCAI'22.** 25th International Conference on Medical Image Computing and Computer Assisted Intervention.
- **MICCAI'21.** 24th International Conference on Medical Image Computing and Computer Assisted Intervention.

MENTORING & COLLABORATIONS

Master's Thesis

- **Shiyani Patel**, Vector Graph Neural Network: Point Cloud Prediction into the Future, University of Pennsylvania, Fall 2021.
- **Alberto Ceballos-Arroyo**, Computational Methodology for the Generation of Genomic Maps from Fluoroscanning Images, National University of Colombia, Fall 2022.

PhD Student Collaborations

- **Karl Schmeckpeper** (Penn CIS PhD, Spring 2020-ongoing).

External Collaboration

- **Computational Scientist, Center for Autism Research**. Pose-based computer vision features for Autistic Spectrum Disorder diagnosis, Spring 2021-ongoing.

PUBLICATIONS

2022 **Patiño, D., Mayya, S., Calderon, J., Daniilidis, K., and Saldaña, D.**, "Learning to Compensate Wind Turbulence with a Team of Robots: A Reinforcement Learning Approach", Robotics and Automation Letters , Under Review.

2022 **Patiño, D., Schmeckpeper, K., Gupta, H., Georgakis, G., and Daniilidis, K.**, "Self-supervised implicit shape reconstruction and pose estimation for video prediction", ICRA Workshop on Motion Planning with Implicit Neural Representations of Geometry - 2022 .

2022 **Patiño, D., Esteves, C., and Daniilidis, K.**, "Level Set Mesher: Single-image to 3D reconstruction by following the level sets of the signed distance function", ICPR 2022 .

2021 **Patiño, D., and Branch, J.W.**, "Cosine-Pruned Medial Axis: A New Method for Isometric Equivariant and Noise-Free Medial Axis Extraction", IEEE Access , https://doi.org/10.1109/ACCESS.2021.3072933.

2020 **Patiño, D., Ceballos-Arroyo, A. M., Rodriguez-Rodriguez, J. A., Sanchez-Torres, G., and Branch-Bedoya, J. W.**, "Melanoma detection on dermoscopic images using superpixels segmentation and shape-based features", 15th International Symposium on Medical Information Processing and Analysis , https://doi.org/10.1117/12.2545300.

2018 **Patiño, D., Avendaño, J., and Branch, J.W.**, "Automatic skin lesion segmentation on dermoscopic images by the means of superpixel merging", International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI) , https://doi.org/10.1007/978-3-030-00937-3_83.

2018 **Goez-Mora, J. E., Londoño-Lopera, J. C., and Patiño, D.**, "Automatic Visual Classification of Parking Lot Spaces: A Comparison Between BoF and CNN Approaches", Workshop on Engineering Applications , https://link.springer.com/chapter/10.1007/978-3-030-00350-0_14.

2017 **de León, J.C.B., Patiño, D., Restrepo, A., and Branch, J.W.**, "Computational Detection of Salient Information to Identify High Stress and Ambiguity Regions in Digital Photoelasticity Images", Image Processing and Applications (IM4E) , https://doi.org/10.1364/ISA.2017.IM4E.2.

2015 **Zhou, S., Goldstein, S., Place, M., Bechner, M., Patiño, D., Potamousis, K., Ravindran, P., Pape, L., Rincon, G., Hernandez-Ortiz, J., Medrano, J. F. and Schwartz, D. C.**, "A clone-free, single molecule map of the domestic cow (Bos taurus) genome", BMC Genomics , https://doi.org/10.1186/s12864-015-1823-7.

2012 **Patiño, D., Mery, D., Fernandez, B.V., Branch, J.W.**, "Automatic Landform Classification of Uplands Based on Haralick's Texture", CLEI XXXVIII - Latin-American Informatics Conference, IEEE , DOI:10.1109/CLEI.2012.6427164.