Emanuel Muñoz

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Interested in safe, intelligent, and autonomous systems, with expertise in learning, safety, and computer vision. I am also keen on exploring their integration with AI, particularly focusing on probabilistic models, explainability, and foundational models. My experience spans diverse projects, including AI-based utilities inspection, autonomous vehicles, surgical robotics, and optimal nonlinear control.

EDUCATION

Carnegie Mellon University, Robotics Institute | MSc in Robotics August 2024 - May 2026 | Pittsburgh, PA, US

Universidad de Ingeniería y Tecnología - UTEC | BS in Electrical Engineering

March 2016 - December 2021 | Lima, Perú

Awarded with Full Academic Scholarship

Cum. GPA: 4.00 | GPA in Peruvian scale: 15.75/20.00 | **Thesis project: Al-curiosity-driven exploration** in mobile robots. Relevant courses: Foundations of Robotics, Image Processing, Machine Learning, Neuroscience, Autonomous Robotics.

RESEARCH AND INDUSTRIAL EXPERIENCE

Carnegie Mellon University - Robotics Institute | Robotics Research Assistant August 2024 - Present | Pittsburgh, PA, US

- Working on safe reinforcement learning for informative path planning applied to wildfire monitoring.
- Collaborating under the supervision of **Prof. Katia Sycara** and **Woojun Kim**.

Noteworthy AI | Machine Learning Engineer

March 2022 - August 2024 | Remote, US

- Designed and implemented C++ ROS2 nodes for depth estimation, data collection, localization, and tracking of distributions poles using stereo depth cameras mounted on fleet vehicles.
- Implemented a high-res image capturing triggered by estimations of detected pole poses.
- Improve deployment for quick launching edge systems using Docker, Bash, Git .
- Developing ML tools for inference and evaluation of detection models in the cloud using PyTorch, AWS, W&B .

Carnegie Mellon University - Robotics Institute, RISS Program | Robotics Research Visitant May 2021 - July 2022 | Remote

- Developed an **adaptive safe control** framework for autonomous vehicles diminishing the effects of model uncertainty based on **control barrier function** and **extreme machine learning**.
- Advised by Qin Lin and John Dolan. Published paper at top conference [IROS 2022].

UTEC - CONCYTEC | Robotics Research Assistant March 2020 – April 2021 | Lima, Perú

- Contributed to building a surgical robotics platform funded by the government by developing a camera framework for feedback sensing using multicamera 3D estimation.
- Implemented a hybrid learning controller for torque-position transformation in manipulator robots. [CDC 2020].
- Compared the tracking performance of robust trajectory controllers in a surgical robot. [ICCAD 2020].

Yale University - Schroers Lab | Research Assistant Jan - March 2020 | New Haven, CT, US

• Sponsored by Research Experience for Peruvian Undergraduates | Supervised by Jan Schroers and Sungwoo Sohn.

• Designed and developed two new alloys with potential mechanical properties for industrial applications.

ISA REP | Digital Image Processing Intern Jun – Dec 2019 | Lima, Perú

- Designed and developed two methods for corrosion detection based on SVM, Random Forest, and NN classification.
- Launched the first phase of automatic supervision of electric powerlines using **drones** and **supervised learning**.
- Developed framework for semantic labeling, classifier training, and GUI prototype. | Tech: scikit, Keras, OpenCV

PERSONAL PROJECTS

End-to-end navigation and exploration robotics | Code, Link

• Developed a deep reinforcement learning agent implemented in a mobile robot with a LiDAR sensor for exploration and navigation tasks based on actor-critic agents. | **Tech: Gym, Torch**

Autonomous Mobile Robotics | Code

- Designed and implemented algorithms for **autonomous motion planning and exploration** on mobile robots in real and simulated environments. | **Tech: ROS, Python, Gazebo**
- Built complete frameworks for mobile robotic applications and **published four papers** showing results.

PUBLICATIONS

- [1] E. Munoz, D. Kalaria, Q. Lin, and J. Dolan, "Online adaptive compensation for model uncertainty using extreme learning machine-based control barrier functions," in 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2022).
- [2] G. García, E. Munoz, and O. E. Ramos, "Torque control in position-controlled robots using an inverse dynamic task," in 2020 59th IEEE Conference on Decision and Control (CDC).
- [3] J. Charaja, E. Munoz, O. E. Ramos, and R. Canahuire, "Trajectory tracking control of ur5 robot: a pd with gravity compensation and sliding mode control comparison," in 2020 International Conference on Control, Automation and Diagnosis (ICCAD).
- [4] E. Denegri, E. Munoz, and O. E. Ramos, "Step-by-step development of an omnidirectional mobile robot," in 2019 IEEE Sciences and Humanities International Research Conference (SHIRCON).
- [5] J.-M. Muñoz, E. Munoz, and O. E. Ramos, "Autonomous motion of a mobile robot based on potential fields and polar control," in 2018 IEEE XXV International Conference on Electronics, Electrical Engineering and Computing (INTERCON).
- [6] E. Muñoz-Panduro and O. E. Ramos, "Random exploration framework for an autonomous real-time generation of a map," in 2018 IEEE XXV International Conference on Electronics, Electrical Engineering and Computing (INTERCON).
- [7] G. Garcia-Chavez and E. Munoz-Panduro, "Global control for the furuta pendulum based on partial feedback linearization and stabilization of the zero dynamics," in *Conference on Automation Science and Engineering (CASE 2017)*.

HONORS AND AWARDS

| - Selected to participate in the Tropical Probabilistic Al Summer School | 2024 |
|-----------------------------------------------------------------------------------------------------------------|------|
| - Selected out of 700+ applicants to participate in CMU's Robotics Institute Summer Scholars (RISS) program | 2021 |
| - Accepted to participate on Eastern European Machine Learning Summer School 2021 | 2021 |
| - Selected out of 300+ students by <u>REPU</u> to work on nano science research internship at Yale University | 2020 |
| - Awarded a travel international grant by <u>UTEC GO</u> to conduct a research internship | 2019 |
| - Accepted with financial support in the International Summer School on Deep Learning for Robot Vision at Chile | 2019 |

COMMUNITY AND LEADERSHIP

Group of Innovation, Research, and Technology

- Led academic group oriented to encourage technology and robotics research at Universidad de Ingenieria y Tecnologia UTEC. Members: +50 students and alumni.
- Started project "New Ocean", a collaborative project to stop ocean pollution using robotics and biotechnology.
- Mentored students on Machine Learning and Computer Vision topics.

Research Experience for Peruvian Undergraduates (REPU)

- Collaborated with <u>REPU</u> to support the communication and the application review teams. REPU is a STEM organization with +100 doctoral and undergraduate students network.
- Presented journal work in the yearly <u>REPU SEMINAR 2020</u>.

OUTSIDE INTERESTS

Decentralized tech, science divulgation, start-up and moonshots, table tennis, Sherlock Adventures, science cooking