Pedro Antonio Peña

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Research Interests

Generative AI, Artificial Intelligence, Deep Generative Models, Transformers, Deep Learning, Reinforcement Learning, Behavior Planning, Human Robot Interaction, Augmented Reality, Motion Synthesis & Retargeting

Education

University of Miami, Miami, FL.

Ph.D., Computer Science, Summer 2020

- Research Topic: *Human Motion Prediction for Robotics*
- Thesis: *Trajectory Planning for Robots and Inverse Trajectory Planning for Humans: A Bridge Between Robots and Humans*
- Advisor: Ubbo Visser, Ph.D.

M.S., Computer Science, May 2019

- Research Topic: *Motion Planning and Human-aware Robotics*
- Thesis: *An Omni-directional Kick Engine for Humanoid Robots with Parameter Optimization*
- Advisor: Ubbo Visser, Ph.D.

B.A., Computer Science (Minor: Mathematics), May 2015

- *Gamma Cum Laude*

Work Experience

Advanced Micro Devices, Inc. (Radeon Technology Group - Advanced Architecture Group)   October 2021 - Present

Gaming AI Staff Engineer

- (2022 & 2023) Generative AI research for character animation (text-to-motion) motivated by Tevet et al., and Zhong et al. (this involved working with Transformers, CLIP, Rectified Flow, Diffusion, Reinforcement Learning, and Codebooks).
- (2021) Developed state-of-the-art AI models for motion synthesis, completion, and & retargeting motivated by the work from Petrovich et al., Harvey et al., and Duan et al. (this involved working with Transformers, VAEs, and CNNs.)
- Development was done using Azure ML and Pytorch.
- Demonstration was done using Unreal Engine 5 and Blender.
- Writing proposals and patents.

Lockheed Martin Space (Advanced Technology Center) September 2020 - October 2021

A/AI Autonomy Research Engineer Sr.

- ML/AI and autonomy research for space robotics - developed a robotic system for plant tending in remote habitats. Wrote a behavior tree planner that interfaced with a ground operator and controlled a remote UR3e robot. Utilized HTC Vive, Unity, ROS, ROS-sharp, and Kafka.
- Researching World Models from Ha & Schmidhuber for deep space exploration (VAEs, RNNs, and CNNs were used for this research).
- Writing proposals.
- Managing and leading junior engineers.

Open Robotics (OSRC)   May 2020 - August 2020

Software Engineer Intern
  - Testing ROS2 Foxy and ROS Noetic release (Debian packages and git repositories).
  - Optimizing thread interactions in Multi-threaded Executor in RCLCPP.
  - Developing features for ROS2 Foxy Fitzroy.

Toyota Research Institute   August 2018 - August 2020
  Software Engineer for **Manipulation** (May 2020 - August 2020)
    - Exploring robotic capabilities through Drake, a multibody dynamics simulator
    for robots.
    - Developing software with C++ and Python.
  Software Engineer for **Virtual Mobility** (June 2019 - May 2020)
    - Worked with Virtual Mobility on navigation and behavior planning for T-TR1,
    a telepresence robot designed by the group I worked with which was composed
    of mechanical, electrical, systems, and software engineers.
    - Reviewing pull requests and issues through GitHub.
    Software development in ROS2 Eloquent/Dashing/Crystal using C++ and Python.
  Robotics Intern for **Outdoor Robotics** (May 2018 - June 2019)
    - Follow-Me behavior planning with a PID controller in ROS2.
    - A nonlinear optimization algorithm to find 3D features from 2D features.
    - The application was following a person who wears an infrared transmitter.
    - Used OpenCV to detect IR features in an image.
    - Developed ROS2 drivers for Bosch BNO055 IMU and Garmin Lidar-Lite v3HP.
    - Used OpenCV and ArUco library and developed a ROS2 package that utilizes
    fisheye cameras to detect AR markers.
    - Built a custom robot with a Turtlebot platform that is composed of a Garmin
    Lidar-Lite v3HP, two fisheye cameras, and a BNO055 IMU.
    - Software development in ROS2 Crystal/Bouncy/Ardent using C++ and Python.

N.A.S.A. Langley Research Center   May 2016 - August 2016
  Software Engineer Intern
    - Software Support for Visualization Display of CALIPSO Satellite Observations.
    - Software development with Bash scripting and Matlab.

Tinybop, Inc.   May 2014 - August 2015
  Software Developer
    - Using the Unity Game Engine to develop educational apps for children. Mostly
    scripting in C#.
    - Released two games while working at Tinybop. The first game produced by the
    team, Homes, won Parent's Choice Awards (Mobile Apps Gold) and the second
    game released, Simple Machines, won App Store Editor's Choice Award.

Research Experience	**Remote Teleoperation**

Remote Teleoperation
The system includes remote teleoperation capabilities, a 6-DOF robotic arm, vision
system for 3D reconstruction of plants, pneumatic multi-tool changer, and custom
end-effectors including an enclosure latch tool and a plant shear tool. This work is a
collaborative effort between NASA Kennedy Space Center, Lockheed Martin Space,
and university partners to test the technologies of autonomous plant growth systems
in deep space: https://youtu.be/la2cIeRszPc?t=465.

Robotics with Augmented Reality
Using the Magic Leap One device to develop a human-robot interface that enables
humans to visualize the internal robot states in the physical world and interact with
the robot. Won a Magic Leap grant to explore intuitive human-robot interfaces
using ROS# and Magic Leap One. A demo of the interface can be found here:
https://www.youtube.com/watch?v=ErFHpEWUaYM.

Humanoid Robotics

Motion planning for kick trajectories while a humanoid robot is walking. I also worked on a ZMP controller for balancing while generating kick trajectories using cubic splines, sextic splines, and cubic Hermite splines. The parameterization of the interpolators were optimized on Webots simulator. A video of the project can be found here: https://www.youtube.com/watch?v=RuJxICOOeoI.

Follow-Me

We used ROS2 as a platform to conduct AI research for developing a Follow-Me capability as a proof- of-concept on a wheeled robot, demonstrating that AI research is possible in the ROS2 framework. I also designed a nonlinear optimization algorithm to find 3D features from 2D features. The application was following a person who wears an infrared transmitter. A video of the project can be found here: https://www.youtube.com/watch?v=1tiOBjOyDfI.

Human Support Robot (*HSR*)

A robot platform for human-robot interaction in homes. I worked on **manipulation** to grasp household items, **navigation**, **behavior planning**, **human-robot interfaces**, and **forecasting human motions**. A video of the project can be found here: https://www.youtube.com/watch?v=Ib6xCcKhsVk$feature=emb_title$.

Pedestrian Forecast Model

Researching feasible methods for robotics systems to forecast the position of a human by fusing sensor data with a probabilistic model. Validating the model using Toyota Human Support Robot and Waymo Open Dataset. A video of the project can be found here: https://www.youtube.com/watch?v=yIV4nPIigXO.

Awards	
• Magic Leap grant to explore intuitive human-robot interfaces	Spring 2020
• Nominated for Best Scientific Paper at RoboCup, Sydney, Australia	July 2019
• Workshop on Robot Joint Learning (IROS), Vancouver, Canada	October 2017
• PRISM Fellowship, University of Miami	August 2016
• Kapor Fellow at Kapor Center for Social Impact, San Francisco	May 2014

Competitions	
• RoboCup@Home, France (*Technical Committee member*)	July 2020
• RoboCup@Home, Sydney, Australia	July 2019
• World Robot Summit (Partner Robot Challenge), Tokyo, Japan (6th place Finalists for Skills Test)	October 2018
• RoboCup@Home, Montreal, Canada	June 2018
• RoboCup SPL, Nagoya, Japan	July 2017
• RoboCup SPL, Leipzig, Germany	July 2016

Publications

1. Hament, B, Oh, P, Carr, D, Moore, C, Dev, S, Ferguson, I, **Pena, P**, Ehrlich, JW. "Robotic System for Plant Tending in Remote Habitat." Proceedings of the ASME 2021 International Mechanical Engineering Congress and Exposition. Volume 7A: Dynamics, Vibration, and Control. Virtual, Online. November 1–5, 2021. V07AT07A019. ASME. https://doi.org/10.1115/IMECE2021-69733

2. **Pedro Peña**. "Trajectory Planning for Humanoid Robots and Inverse Trajectory Planning for Service Robots: A Bridge Between Robots and Humans". N.p., 2020. Print.

3. R.E. Curiel-Cid and E.A. Crocco and M. Kitaigorodsky and L. Beaufils and **P.A. Peña** and G. Grau and U. Visser and D.A. Loewenstein, "A novel computerized cognitive stress test to detect mild cognitive impairment," The Journal of Prevention of Alzheimer's Disease - JPAD, pp. 1–7, July 2020.

4. **Pedro Peña** and Ubbo Visser. "ITP: Inverse Trajectory Planning for Human Pose Prediction". Künstl Intell 34, 209–225 (2020). https://doi.org/10.1007/s13218-020-00658-7

5. **Pedro Peña** and Ubbo Visser (2020). "Adaptive Walk-Kick on a Bipedal Robot". In Stefan Chalup et al., editor, RoboCup 2019: Robot Soccer World Cup XXIII. Springer Berlin / Heidelberg, 2020. **Best Scientific Paper Award Candidate**, to appear.

6. **Pedro Peña** and Toffee Albina (2019). "Follow Pedro! An Infrared-based Person-Follower using Nonlinear Optimization". arXiv preprint arXiv:1912.06837.

7. **Peña, Pedro**, "An Omni-Directional Kick Engine for NAO Humanoid Robot" (2019). Open Access Theses. 751. (Master's Thesis)

8. **Peña, Pedro**, Mihai Polceanu, Christine Lisetti, and Ubbo Visser. "eEVA as a Real-time Multimodal Agent Human-Robot Interface." *RoboCup 2018: Robot Soccer World Cup XX*. Springer Berlin / Heidelberg, 2019. to appear.

9. **Peña, Pedro**, Joseph Masterjohn, and Ubbo Visser. "Optimizing Kick Trajectory: A Comparative Study." *3rd Global Conference on Artificial Intelligence*. EPiC Series in Computing, 50:239-245, 2018.

10. **Peña, Pedro**, Joseph Masterjohn, and Ubbo Visser. "An Omni-directional Kick Engine for Humanoid Robots with Parameter Optimization." *RoboCup 2017: Robot Soccer World Cup XX*. Springer Berlin / Heidelberg, 2018.

11. Poore K., Masterjohn J., Seekircher A., **Peña P.**, Visser U. "DTMF Audio Communication for NAO Robots." *FLAIRS 2017 - Proceedings of the 30th International Florida Artificial Intelligence Research Society Conference*, pp. 448-453, 2017.

12. **Peña, Pedro A.**, Dilip Sarkar, and Parul Maheshwari. "A Big-Data Centric Framework for Smart Systems in the World of Internet of Everything." *Computational Science and Computational Intelligence (CSCI), 2015 International Conference on*. IEEE, 2015.

Teaching Experience	CSC210 - Scientific Computing	Fall 2016 - Fall 2018
	CSC322 - C Programming and Unix	Spring 2017
	CSC424 - Computer Networks	Spring 2016
	CSC120 - Computer Programming I	Spring 2016
	CSC419 - Programming Languages	Fall 2015
	CSC120 - Computer Programming I	Fall 2015

Hardware and Software Skills

Computer Programming:
- C, C++, CMake, Python, Unity, Git, PyTorch, Tensorflow

Robotics:
- GazeboSim, Robotic Operating System (ROS/ROS2), Magic Leap, Webots Simulator, V-Rep Simulator, Point Cloud Library (PCL)