

Michael A. Pfeiffer

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RESEARCH INTERESTS

My research interests lie within the interdisciplinary application of computational sciences and engineering to the natural and social sciences to help develop solutions for problems faced within the world. While broad, this description more specifically includes:

- Incorporation of varying cognitive robotic approaches to create compliant intelligent systems that are capable of assisting with rescue missions and/or healthcare
- Development of neurobotic models to understand animal neurobiology and behavior
- Neuromorphic computing/engineering to enable more parallel and event-driven software in neurobotic applications
- Investigate ways to improve the general public's trust in artificial intelligence and robots
- Development of computational methods for the generation, understanding, and prediction of organic chemical mechanisms
- Development of computational methods using non-contact sensors to infer the cognitive state of a subject

EDUCATION

Oregon State University (*September 2024 - Present*)

Ph.D., Robotics

University of California, Irvine (*September 2021 - June 2024*)

B.S., Computer Science and Engineering

B.S., Cognitive Science

Mount San Antonio Community College (*August 2018 - June 2024*)

CIS Certificate, Object-Oriented Design (*June 2021*)

RESEARCH EXPERIENCE

Research in Applied Decisions Laboratory (RADlab), Oregon State University (*September 2024 - Present*)

Graduate Student Researcher

Principal Investigator: Professor Cristina Wilson, Collaborative Robotics and Intelligent Systems (CoRIS) Institute, Oregon State University

Research Subject: Underwater Manipulation

Research Topic: [In Progress]

Research Question: [In Progress]

Research Importance: [In Progress]

Role Description: [In Progress]

Cognitive Anteater Robotics Lab (CARL), University of California, Irvine (*March 2023 - June 2024*)

Undergraduate Student Researcher

Principal Investigator: Professor Jeffrey L. Krichmar, Department of Cognitive Sciences,
University of California, Irvine

Research Subject: Neurorobotics

Research Topic: Development of *CuttleBot*: a cognitive machine inspired by cuttlefish
neurobiology and behavior

Research Question: How can we model a cuttlefish in a robot system and test our model to
ensure that it displays complex cognitive abilities?

Research Importance: Enable a better understanding of the necessary architecture for
intelligence as the neural architecture of our cuttlefish model can be compared to that of
intelligent vertebrates (e.g., primates, corvids, etc.)

Role Description: As part of the engineering team, my responsibilities include working with the
cognitive science team to gain a better understanding of cuttlefish behavior and sensory
abilities to select the appropriate hardware and program the appropriate functionality into
the robot, working with the art team to ensure the structure of the robot fits its intended
morphology, and working with the neuroscience team to learn more about the brain
connectivity of the cuttlefish to inspire an artificial neural network that guides the robot's
behavior.

Van Vranken Group, University of California, Irvine (*September 2021 - June 2024*)

Undergraduate Student Researcher

Principal Investigator: Professor David Van Vranken, Department of Chemistry, University of
California, Irvine

Research Subject: Chemoinformatics

Research Topic: Development of *Reaction Predictor*: a web application that applies machine
learning to rank the possible products and stepwise mechanisms of organic reactions

Research Question: Can we develop a tool that can predict the products and stepwise
mechanisms of organic reactions?

Research Importance: Enable a quicker understanding of the resulting products from organic
reactions in applications such as pharmaceutical synthesis/degradation, atmospheric
organic chemistry, and polymer degradation.

Role Description: As a computer science student on a chemistry team, my role is to work alongside chemists to enable the use of different technologies and learn the theory behind organic chemical mechanisms to build programs that assist with the generation of stepwise mechanistic datasets. Currently, this work consists of setting up environments to enable the testing of published reaction prediction software and developing algorithms to acquire the functional group of a molecule based on conjugation, cross-conjugation, and stereochemical effects.

Human Neuroscience Lab (HNL), University of California, Irvine *(June 2023 - December 2023)*

Undergraduate Student Research Assistant

Principal Investigator: Professor Ramesh Srinivasan, Department of Cognitive Sciences, University of California, Irvine

Research Subject: Computational Neuroscience

Research Topic: Making inferences about a subject's cognitive state through the analysis of thermal facial images via machine learning models

Research Question: How can we determine the cognitive state of a person without relying on sensors that require direct contact?

Research Importance: Enable a more convenient method for making inferences about a person's cognitive state, allowing for easier application outside of a controlled laboratory setting

Role Description: As a computer science student, I am more involved with the computer vision aspects of the project. Currently, my work involves applying methods to detect and stabilize thermal facial images, training a machine learning model to accurately predict the difficulty of a task (easy, medium, or hard) a person is working on, and utilizing a model interpreter to understand the relevant features the model uses for making predictions.

Student Success and Transfer Articulation through Research and Support Services (STARS)

Program, California State Polytechnic University, Pomona *(February 2022 - May 2022)*

Research Program Fellow

Program Director: Dr. Winny Dong

Mentor: Professor Eugene Mahmoud, Department of Physics and Engineering, Mount San Antonio College

Research Subject: Robotics

Project Title: "Application of Color Vision and Pathfinding for Autonomous Planning in VEX Robotics"

Research Question: Can we develop a robust and dynamic autonomous path-finding system inspired by Hirt et al.'s quadtree approach within the context of the VEX Robotics Competition (VRC)?

Research Importance: Enable VEX Robotics teams to develop complex autonomous routines with minimal programming knowledge.

Research Poster: https://drive.google.com/file/d/126LrGeD-Kp1mmEdQA_lqs1eF71GKSedE/view?usp=sharing

Description: A 16-week part-time research program, working on a team project to make use of the VEX V5 Inertial Sensor and Color Vision Sensor to update a quadtree-based virtual map for use in path planning. The goal of the project was to create and test a library that any VEX Robotics team could use to increase the performance of their autonomous code. My role as the programming lead for this project was to develop the code for building and updating the quadtree data structure and also help guide students working on the path-planning aspect of the project. The result of the project was unfortunately unfinished due to time constraints; however, initial modules and a theoretical framework for how everything works together were documented for younger members of the team to continue if they so chose.

Research Fellowship supported by the U.S. Department of Education STARS Program Grant

Preparing a Technical Workforce Through Undergraduate Research or Internship, Mount San Antonio Community College (June 2021 - August 2021)

Research Program Fellow

Principal Investigators: Dr. Iraj B. Nejad & Dr. Alvin Kung

Mentor: Professor David Van Vranken, Department of Chemistry, University of California, Irvine

Research Subject: Chemoinformatics

Project Title: "Utilization of Chemoinformatic Tools for Further Training of *Reaction Predictor*"

Research Question: Can we use Herbert Mayr's database of reactivity parameters to build a more detailed dataset of mechanistic steps, consisting of estimations for the rate constants of each mechanism?

Research Importance: Enable AI models in the chemical sciences to better learn the correct products and arrow-pushing mechanism of an organic chemical reaction.

Research Poster: <https://drive.google.com/file/d/1Yg3YVh0h5aJv29Jw8X8M3VEK0gQAbRWy/view?usp=sharing>

Description: An 8-week full-time summer research program, gaining introductory organic chemistry knowledge alongside chemoinformatic concepts to help develop a program to generate a dataset of single-step polar reactions. The goal of this project was to combinatorially generate the single-step reactions and use the associated Mayr equation to give an associated plausibility for each reaction. Together, this would hopefully allow for better training of the deep-learning model used by the *Reaction Predictor* web application (UCI ChemDB Portal). This task was accomplished by using the Python Chemoinformatics library known as RDKit which made programmatically combining molecules easier and also enabled the use of substructure searching on the generated data.

Research Fellowship supported by the NSF ATE Award #202427

PUBLICATIONS

Journal Publications:

- M. Tavakoli, R.J. Miller, M.C. Angel, **M.A. Pfeiffer**, E.S. Gutman, A.D. Mood, D. Van Vranken, & P. Baldi. (2024). "PMechDB: A Public Database of Elementary Polar Reaction Steps." *Journal of Chemical Information and Modeling*, vol 64, iss 6, pp 1975–1983. DOI: <https://doi.org/10.1021/acs.jcim.3c01810>.

Conference Publications:

- M.A. Pfeiffer, S. Kandimalla, J. Liu, K. Hsu, E.J. Kirshner, A. Yuan, H.W. Lui, & J.L. Krichmar. (2025). "CuttleBot: Emulating Cuttlefish Behavior and Intelligence in a Novel Robot Design." In: *From Animals to Animats 17*, Editors: O. Brock & J.L. Krichmar, Conference: 17th International Conference on the Simulation of Adaptive Behavior (SAB 2024). *Lecture Notes in Computer Science*, vol 14993, pp 93–105. Springer, Cham. DOI: https://doi.org/10.1007/978-3-031-71533-4_7.

In-Press Articles:

- [Currently no articles in-press]

Submitted Manuscripts:

- [Currently no submitted work]

TEACHING EXPERIENCE

Computer Science Club, Mt. San Antonio Community College (August 2019 - June 2021)

Tutor

Description: Tutored lower-division computer science concepts (e.g., pointers, object-oriented programming, and data structures) 2-4 hours a day for two days a week.

LEADERSHIP & TEAM EXPERIENCE

VEX Robotics Team, Mount San Antonio Community College (October 2019 - June 2021)

Programmer

Description: Part of the VEX Robotics Competition (VRC) engineering team programming robots roughly 18"x18"x18" in size to compete in a 2v2 match with other college teams. The competition involved two stages: autonomous and user-control. So a lot of collaboration occurs between builders, drivers, and programmers to ensure that everything works well together and can be used comfortably by the driver. Being a yearly competition, I participated in two games: Tower Takeover, where the objective was to stack more cubes on your side of the field than your opponent and Change Up, where you had to intake balls and score them in cylindrical containers. For the Tower Takeover competition, our team succeeded in making it to the VEX Worlds Competition but was unfortunately canceled due to the 2020 pandemic.

Developer Student Club, Mount San Antonio Community College *(August 2020 - June 2021)*

Technical Lead

Description: Main responsibilities included learning about new concepts to explain and talk about in technical workshops as well as helping with team formation for the yearly Google Solution Challenge.

Computer Science Club, Mount San Antonio Community College *(August 2019 - August 2020)*

President

Description: Main responsibilities included leading the officer team to accomplish club goals such as hosting workshops, tutoring sessions, and forming teams for hackathons. A shift in responsibilities occurred when transitioning from in-person to online during the 2020 pandemic. From then on, more focus was put on building an active online community and prepping next year's officers for a smooth transition during uncertain times.

CONFERENCE PARTICIPATION

2021 Advanced Technological Education Principal Investigators' Conference *(October 2021)*

Description: Virtual conference where I was able to present a poster detailing the work I did over my 8-week summer research program (see "Preparing a Technical Workforce Through Undergraduate Research or Internship, Mount San Antonio College").

AWARDS & HONORS

2021 Advanced Technological Education Student Award for Excellence *(October 2021)*

Description: Award given "...from NSF and AACC to commemorate [my] achievement in advanced technological education." Award received through the nomination of the program's PIs to participate and present my work at the 2021 ATE PI Conference (see "2021 Advanced Technological Education Principal Investigators' Conference").

President's List, Mount San Antonio Community College *(August 2018 - June 2021)*

Description: An honors list of full-time students who received at least a 3.5 GPA for the academic semester.

Dean's Honor List, University of California, Irvine *(September 2021 - March 2022, January 2023 - March 2023)*

Description: Honors list of full-time students who received at least a 3.5 GPA for the academic quarter.

Julian Feldman Endowed Scholarship (2022 - 2023 Academic Year)

Description: A \$2,000 scholarship given on the basis of high academic standing and possession of demonstrated leadership abilities.

TECHNICAL SKILLS

Software

Programming Languages: C/C++, Python

Frameworks & Libraries: PyTorch, RDKit, Scikit-Learn, AVR-LibC

Version Control Software: Git

CAD Tools - 3D Modeling: FreeCAD, SolidWorks

CAD Tools - Electronic Design: KiCAD EDA

Hardware

Microcontrollers (MCUs): ATmega32

Microcontroller Boards: Lego SPIKE Prime, Arduino Uno, Arduino Nano

Single-Board Computers: Raspberry Pi 4B, VEX V5 Robot Brain