# Michael R. Martin

PhD Student & Graduate Researcher
University of California, Davis

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## Research Interests

Computer vision; generative vision models and representation analysis; machine learning; representation learning; geometry and 3D shape; computational imaging; computer graphics and visual abstraction; augmented, virtual, and mixed reality; interpretability and robustness in learned models; differentiable and inverse models for visual inference; learned scene representation and reconstruction; foundational methods for stable, reliable visual systems

## Current Research

Mechanistic Interpretability of Structured Signals in Generative Vision Systems
- **Summary:** https://michaelmartintech.github.io/assets/Xpert.pdf

Neural Representations for Interactive Exploration of Complex Volumetric Data
- **Summary:** https://michaelmartintech.github.io/assets/AIVER.pdf

Embodied XR Systems for Immersive Interaction
- **Summary:** https://michaelmartintech.github.io/assets/proneVR.pdf

## Education

**Ph.D. Student, Computer Science |** University of California, Davis | 2025 – Present
Advisor: Dr. Kwan-Liu Ma

**B.Sc., Computer Science & Engineering (Major) |** Minor: Digital Interactive Game Design
University of Nevada, Reno | 2020 – 2025
GPA: 3.66 / 4.00

**Undergraduate Coursework in Computer Science |** University of Washington, Bothell (2019 – 2020)
GPA: 3.77 / 4.00

## Selected Publications & Preprints

*Interpreting Structured Perturbations in Image Protection Methods for Diffusion Models*
**Martin, M. R.,** Chan, G., Ma, K.-L.
**arXiv**:2512.08329, Dec 2025. (Preprint)
http://arxiv.org/abs/2512.08329

*ProneXR: A Posture-Aware Real-Time XR Rendering Architecture for Embodied Immersive Computing*
**Martin, M. R.,** Chan, G., Jung, M.J., Ma, K.-L.
(Manuscript in preparation)

## Additional Peer-Reviewed Publications

*Impacts of Wildfire Smoke Aerosols on Radiation, Clouds, Precipitation, Climate, and Air Quality*

Barjeste Vaezi, R., **Martin, M. R.**, Hosseinpour, F.
Atmospheric Environment X, Elsevier, Vol. 26, 100322, 2025. (Published)
https://doi.org/10.1016/j.aeaoa.2025.100322

***Stepwise Clustered Ensemble (SCE): An R Package for Interpretable Robust Regression in Environmental Modeling***
Li, K., **Martin, M. R.**, Wang, X., Hosseinpour, F.
Environmental Modelling and Software, 2025. (Under Review)
Manuscript ID: ENVSOFT-D-25-02742

***Deep Learning Framework for Predicting Wildfire Smoke from Satellite Remote Sensing Data***
**Martin, M. R.,** Yang, L., Moosmüller, H. (Ready for submission)

## Selected Talks & Presentations

***Explainable AI for Analyzing the Impacts of Data Purification on Image Models***
**Martin, M. R.,** Chan, G., Ma, K.-L.
VIDi Labs, UC Davis, Nov 9, 2025. (Talk)
https://doi.org/10.13140/RG.2.2.21023.42408

***ProneVR: Design and Evaluation of a Controller-Free Immersive VR for Pain Management***
**Martin, M. R.,** Chan, G., Ma, K.-L.
Pain Medicine Dept., UC Davis Health, Nov 24, 2025. (Invited Talk)
https://github.com/MichaelMartinTech/ProneVR-Demo

***Visualizing the Impact of Data Perturbation on Image Models using Explainable AI***
**Martin, M. R.,** Chan, G., Ma, K.-L.
VIDi Lab, UC Davis, Dec 5, 2025. (Talk)
https://doi.org/10.13140/RG.2.2.32382.45126

## Research Experience

**Ph.D. Graduate Student Researcher,** Visualization & Interface Design Innovation (VIDi) Lab, University of California, Davis | June 2025 – Present
Advisor: Dr. Kwan-Liu Ma

- **Diffusion-based generative model interpretability:** Designed and developed perturbation-based frameworks for robustness and feature-level interpretability of text-to-image diffusion models; first-author arXiv preprint and journal manuscript in preparation.
- **ProneVR (constraint-aware, controller-free XR systems):** Designed and implemented an immersive therapeutic VR environment integrating real-time rendering, shader-based visual effects, spatial audio, interactive simulation, and AI-driven agent behaviors; led system evaluation at the clinical study at UC Davis Health; first-author manuscript in preparation.
- **Neural and Gaussian scene representations for volumetric visualization:** Authored and developed a research proposal for real-time VR visualization of unstructured volumetric data using Gaussian splatting and neural-guided sampling, encompassing a scalable OpenXR-based system supporting multivariate transfer-function editing and AI-accelerated rendering.
- **GPU-Accelerated Time-Varying Volumetric Visualization:** Implemented CUDA-based pipelines for high-performance time-varying volumetric visualization.
- **Graduate Mentorship:** Provided graduate-level mentorship to a master's student on XR system architecture and XAI methodologies for generative image models.

**NASA Research Fellow**, **Nevada NASA Space Grant,** Desert Research Institute (DRI) & University of Nevada, Reno | June 2024 – June 2025
Advisors**:** Dr. Lei Yang and Dr. Hans Moosmüller • Program Director: Dr. Eric Wilcox
- Principal student investigator on a funded NASA research proposal.
- Developed and evaluated ensemble and deep learning models for wildfire behavior and smoke-dispersion prediction using large-scale NASA satellite data.
- First author on a manuscript for peer-reviewed publication. Presented results at the UNR Data Science Conference and the Nevada NASA Statewide Meeting.

**Research Fellow, SMART Lab (Science & Mathematics of AI Modeling for Research and Technology)**
Desert Research Institute | June 2023 – June 2024
Supervisor: Dr. Hans Moosmüller • Mentors: Dr. Lei Yang and Dr. Kailong Li
- Developed scientific computing and machine-learning pipelines for NASA EPSCoR-supported research, including model development, validation, XAI analysis, and large-scale data processing.
- Co-authored two peer-reviewed papers (one published, one under review) and contributed core ML components to federal research proposals submitted to NOAA and CAL FIRE.
- Presented research at the American Meteorological Society National Conference.

**Research Assistant, Organic Analytical Lab,** Desert Research Institute | June 2022 – June 2023
Supervisor: Dr. Andrey Khlystov • Mentor: Dr. Kevin Axelrod
- Developed data analysis and visualization pipelines for a NIH-funded research project; authored technical reports summarizing experimental methods, analysis, and key findings.

**Research Assistant, Robotics Lab,** University of Nevada, Reno | Sept 2018 – June 2019
Advisor: Dr. Monica Nicolescu
- Assisted with C++ modules for robotic simulation, supporting algorithmic behavior testing and system functionality for autonomous robotics experiments.

**Independent Research (SensePhase) |** Jan 2018 – Present
- Conducted independent research and prototyping in immersive computing, XR systems, neural rendering, interactive simulation, spatial audio, and AI-driven visual computing, with directions later developed into formal graduate research.

## Fellowships & Grants

**Excellence Graduate Fellowship,** Computer Science, University of California, Davis | 2025 – 2026
Fully funded graduate fellowship.

**NASA Space Grant Undergraduate Fellowship,** Nevada NASA Programs | 2024 – 2025
Highly competitive NASA-funded research fellowship.

**NSF CREATE Scholar,** University of Nevada, Reno | 2020 – 2024
NSF-funded selective research scholarship.

**Dean's Merit Scholarship,** University of Nevada, Reno | 2025
University-wide merit scholarship.

**Merit-Based Undergraduate Fellowship,** University of Washington, Bothell | 2019 – 2020
Merit-based Computer Science admission fellowship.

**Millennium Scholarship (Merit-Based),** Nevada State Treasurer's Office | 2020 – 2024
Statewide academic merit scholarship.

## Honors & Awards

**ACM Hackathon Public Choice Award,** University of Nevada, Reno | 2025
Conceptualized and developed an interactive real-time wildfire simulation.

**Public Choice Award,** Innovation Day Competition, University of Nevada, Reno | 2024
University-wide engineering capstone competition.

**Round 2 Winner,** Sontag Entrepreneurship Competition, University of Nevada, Reno | 2024
University-wide technology-driven innovation competition.

**Top Nevada Finalist & Honorable Mention,** MathCON National Competition | 2016
Statewide finalist; national final competition honorable mention.

**U.S. President's Award for Outstanding Academic Excellence** | 2016
National academic recognition.

## Research Proposals

*AI for Volumetric Exploration in Reality (AIVER) – Real-Time Virtual Reality Visualization of Unstructured Volumes Using Gaussian Splatting and AI-Accelerated Rendering*
**Martin, M. R.**
Independent research proposal, Nov 2025. (Active)
Conceived core ideas, designed the full methodology, and authored the complete proposal.
https://doi.org/10.13140/RG.2.2.27634.36807

*Visualizing the Impact of Data Perturbation on Text-to-Image Models using Explainable AI*
**Martin, M. R.,** Chan, G.
Research proposal submitted to UC Davis, Oct 2025. (Active)
Led the project, conceived, designed, and authored the complete proposal.
https://doi.org/10.13140/RG.2.2.15151.39849

*Advancing Predictive Modeling in Earth Science through AI*
**Martin, M. R.**
**NASA**-funded research proposal, Jan 2024. (Completed)
Principal Student Investigator. Conceived, designed, and authored the full proposal.
https://doi.org/10.13140/RG.2.2.18624.34567

*Enhancing Wildfire Predictability with Physics-Guided AI/ML*
**Martin, M. R.,** Yang, L., Moosmüller, H.
CAL FIRE-funded research proposal, 2024. (Funded)
Contributed to research development and machine learning methodology.

## Selected Projects & Systems

**Interpreting Structured Perturbations in Diffusion-Based Generative Models**
  University of California, Davis | Advisor: Dr. Kwan-Liu Ma | 2025 – Present
- Developed an XAI framework for analyzing robustness, prompt sensitivity, and feature-level behavior in text-to-image diffusion models under structured perturbations.
- Implemented perturbation pipelines and attribution visualizations to study artist-focused image-poisoning defenses.
**Code**: https://github.com/MichaelMartinTech/Adversarial-Perturbation

**AI for Volumetric Exploration in Reality (AIVER)**

University of California, Davis | Advisor: Dr. Kwan-Liu Ma | 2025 – Present

- Developing a VR volume-rendering pipeline using OpenXR and GPU-accelerated rendering for immersive visualization of unstructured volumetric data.
- Investigating Gaussian splatting for interactive, real-time volumetric visualization.

**ProneVR: Controller-Free Embodied XR Systems for Clinical Use**

University of California, Davis | Advisor: Dr. Kwan-Liu Ma | 2025 – Present

- Developed an immersive therapeutic VR platform integrating real-time rendering, custom shader-based visual effects, spatial acoustics, and AI-driven interactive simulation.
- Designed and implemented the end-to-end XR software architecture, including rendering pipelines, interaction subsystems, and audio–visual synchronization.

**Demo**: https://github.com/MichaelMartinTech/ProneVR-Demo
**Code**: https://github.com/MichaelMartinTech/ProneVR-Demo/tree/main/VR_WaterDemo

## Additional Projects & Leadership

**Fire Season Interactive Simulation System — ACM Hackathon** | 2025
Developed an interactive wildfire system in Godot featuring procedural terrain generation, raycasting-based interaction, adaptive AI-driven balancing, and interactive in-engine UI systems.

**VR Software for Medical/Ocular Diagnosis** | 2024
Developed a VR-based visual field assessment prototype in Unity, integrating immersive interface design with desktop simulation workflows to explore software-based ophthalmic diagnostics.
Patent application in progress.

**Plato Mentorship Platform – Capstone Project** | 2023 – 2024
Engineered a scalable web platform using Svelte/SvelteKit, Firebase, and API integrations to support mentor-mentee matching and user management.
GitHub: https://github.com/Mamaril-Jeremy/CS425-Project

**Interactive Media & Simulation Prototypes – Independent** | 2016 – 2024
Built real-time interactive simulation prototypes in Unity and Godot, integrating physics-based engines, AI behaviors, rendering and animation, procedural visual generation, and end-to-end audiovisual pipelines (e.g., pathfinding and navigation systems, algorithm visualization, and game AI).

**Audio Design – Independent** | 2016 – Present
Conducted long-term work in digital sound design, spatial audio algorithms, and acoustics simulation with applications to interactive and immersive media.

## Technical Skills

**Programming Languages**
C++, Python, Java, JavaScript, C#, SQL, Lua, Scheme, GDScript

**Graphics & Rendering**
GPU-accelerated rendering (OpenGL/GLFW, CUDA), shader programming, real-time graphics (Unity, Ogre3D), 3D asset workflows (Blender)

**Interactive XR Systems**
XR system development (OpenXR, Unity, Godot); real-time interaction, physics-based simulation, embodied and immersive system design

**Machine Learning & AI**
Deep learning, generative models, XAI, predictive modeling (PyTorch, TensorFlow, scikit-learn)

**Scientific Computing**
Numerical computing and data analysis (NumPy, Pandas), pattern recognition, large-scale data processing, time-series analysis, and scientific visualization

**Audio & Acoustics**
Spatial audio & acoustic simulation for interactive and immersive systems, procedural audio techniques

**Web-Based Research Systems**
Svelte/SvelteKit; HTML/CSS/JavaScript; Firebase; Cloudflare; web development for research platforms

**Development Environment**
Linux/Unix, Git/GitHub

## Teaching Experience

**Tutor**, University Tutoring Center, **University of Nevada, Reno** | 2020 – 2022
Courses: CS 135 (Introduction to Computer Science), PHYS 180/181 (Physics for Scientists & Engineers)

**Tutor** – **Robert McQueen High School**, Reno | 2017 – 2019
Subjects: AP Physics, AP Calculus, Trigonometry, Geometry, Algebra

## Other Conferences & Invited Presentations

***Advancing Earth Science Predictive Modeling through Machine Learning and Deep Learning.***
**Martin, M. R.**, Yang, L., Moosmüller, H.
Nevada **NASA** Statewide Annual Meeting, March 2025. (Poster)
https://doi.org/10.13140/RG.2.2.28797.06881

***Harnessing Machine Learning and NASA Satellite Big Data for Enhanced Wildfire Smoke Prediction***
**Martin, M. R.**, Yang, L., Hosseinpour, F.
Data Science Conference, University of Nevada, Reno, Feb 2025. **(Invited Talk)**
https://doi.org/10.13140/RG.2.2.28208.06406

***Leveraging Machine Learning and NASA Satellite Data to Improve Wildfire Smoke Prediction***
**Martin, M. R.**, Yang, L., Hosseinpour, F.
Data Science Conference, University of Nevada, Reno, Feb 2025. (Poster)
https://doi.org/10.13140/RG.2.2.32402.36808

***Predictive Modeling in Environmental Science with Machine Learning Algorithms***
**Martin, M. R.**, Mehdizadeh, G., Barjeste Vaezi, R. B., Erfani, E., Hosseinpour, F.
**American Meteorological Society** 104th Annual Meeting, Jan 2024. (Poster)
https://doi.org/10.13140/RG.2.2.18875.18729/2
Abstract ID: 2024AMS-10440178N

***Machine Learning for Exploring Wildfire Smoke Emissions: A Data-Driven Approach***
Brjeste Vaezi, R., **Martin, M. R.**, Hosseinpour, F.
Nevada NASA Statewide Annual Meeting, March 2024. (Talk)
https://doi.org/10.13140/RG.2.2.32342.05449/1

***Machine Learning Approach for Enhanced Understanding of California's Wildfire Smoke***
Barjeste Vaezi, R., Mehdizadeh, G., **Martin, M. R.**, Hosseinpour, F.
**American Meteorological Society** 104th Annual Meeting, Jan 2024. (Poster)

https://doi.org/10.13140/RG.2.2.23069.49120/1

***Development of a Mentorship Platform: Plato***
**Martin M. R.,** Cao R., Mamaril J., Marsala M.
Innovation Day Competition, University of Nevada, Reno, April 2024. (Poster)
https://doi.org/10.13140/RG.2.2.27012.95361

***Cloud Seeding Effects on Snowfall: Insights from Microphysical Model and Satellite Remote Sensing***
Mehdizadeh, G., Hosseinpour, F., **Martin, M. R.,** Barjeste Vaezi, R., Erfani, E., McDonough, F.
**American Meteorological Society** 104th Annual Meeting, Jan 2024. (Poster)
https://doi.org/10.13140/RG.2.2.36071.83369/1

***Innovative Mentorship Platform: Plato***
**Martin M. R.,** Cao R., Jones J., Mamaril J., Marsala M.
Sontag Entrepreneurship. University of Nevada, Reno, Jan 2024. (Talk)
https://doi.org/10.13140/RG.2.2.33723.84006

## Final Technical Reports

***Explainable AI (XAI) for Visualizing the Impact of Data Perturbation on Image Models***
**Martin, M. R.,** Chan, G.
Final Technical Report, VIDi Labs, University of California, Davis, 2025.
https://doi.org/10.13140/RG.2.2.29027.00808

***Advancing Predictive Modeling in Earth Science through Artificial Intelligence***
**Martin, M. R.**
NASA-funded Final Technical Report, 2025.
https://doi.org/10.13140/RG.2.2.18624.34567

***Plato Mentorship Platform***
**Martin, M. R.,** Cao, R., Mamaril, J., Marsala, M.
Undergraduate Capstone Project Technical Report, University of Nevada, Reno, 2024, 171 pp.
https://doi.org/10.13140/RG.2.2.23657.51043

## Professional Development

**NeuralStorm Workshop,** University of California, Davis | 2025
Training in neuroengineering, hands-on projects in Python, neural data processing and machine learning

**Teaching Assistant Training**, University of California, Davis | 2025

**Machine Learning Certificate**, AMS Short Course: *Machine Learning in Python for Environmental Science Problems* | 2024

## Professional Affiliations

Member, **Association for the Advancement of Artificial Intelligence (AAAI**) | 2024 – Present
Member, **Association for Computing Machinery (ACM)** | 2018 – Present
Member, **Google Developer Groups (GDG)** | 2024 – Present
Member, **American Meteorological Society (AMS)** | 2023 – Present