Michael R. Martin

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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

ProneVR: A Posture-Aware Real-Time VR 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