Sydney Katz

Co-founder and CTO – Valgo

I am co-founder and CTO of Valgo (Valgorithmic, Inc.), a company focused on building safety validation tooling to support autonomous systems development and certification. I have deep expertise in algorithmic safety validation through my doctoral and postdoctoral research in the Stanford Intelligent Systems Laboratory. I also wrote a textbook called Algorithms for Validation and teach a related course at Stanford.

@ sydney@valgo.dev sydneymkatz.com smkatz12

EDUCATION

Stanford University

Aeronautics and Astronautics, MS/PhD

2018 – 2023 Stanford, CA

- **GPA**: 4.14 / 4.0
- **Thesis:** Safe Machine Learning-Based Perception via Closed-Loop Analysis

Washington University in St. Louis

Electrical and Systems Engineering, BS/BSAS

2014 – 2018 St. Louis, MO

- **GPA**: 4.0 / 4.0
- **Valedictorian**

RESEARCH EXPERIENCE

Stanford Intelligent Systems Laboratory

Researcher Fall 2018-Fall 2025 Stanford, CA

Keywords: *safety-critical machine learning, perception, autonomy, validation, verification*

Postdoctoral Research

- Researching methods related to the **design and validation of safety-critical automated decision-making systems**
- **Algorithms for Validation:** authoring a textbook on algorithms for validating the performance of safety-critical decision-making systems using topics from optimization, probability theory, and formal methods <online version>
- **Mechanistic Interpretability:** exploring the ability to scale a traditional dictionary learning algorithm to disentangle high-dimensional embeddings from transformer models such as LLMs <paper> <code>
- **Uncertainty Quantification:** developing new techniques to quantify uncertainty in the pose estimation process for a vision-based landing system <paper> <code>
- **Mentoring** Master's and PhD students to set research goals, develop new ideas, and manage industry partnerships

Graduate Research

- **Perception System Safety Requirements:** developed efficient approach for determining safety requirements for perception systems <paper> <video> <code>
- **Safe Design of Perception Systems:** designed safer perception systems using a risk-driven approach that accounts for closed-loop safety properties <paper> <video> <code>
- **Verified Neural Network Perception:** created a method to formally verify image-based neural network controllers that uses generative models to capture the set of plausible inputs <paper> <video> <code>
- **Probabilistic Safety Guarantees for Neural Networks:** developed a technique to analyze the safety of neural network controllers used in stochastic environments <paper> <video> <code>
- **Preference-Based Learning:** used to develop a principled approach to generating realistic models from expert knowledge when data is scarce <paper> <code>
- **ACAS Xr:** extended ACAS X framework to apply to UAM vehicles by developing airspace models and new collision avoidance logic in initial concept study <paper><code>

Water Out Of Thin Air (WOOTA)

Chief Technology Officer Fall 2014-Fall 2017 St. Louis, MO

Keywords: *student-run, startup, design team*

- Designed a device that turns humidity into potable drinking water for people in developing countries
- Won the Washington University **Engineering Discovery Competition**, receiving $25,000 for further development
- Iterated through three functioning prototypes while optimizing the efficiency of the design

Aqueous Geochemistry and Mineralogy Group

Undergraduate Student Researcher Fall 2014-Spring 2016 St. Louis, MO

Keywords: *remote sensing, Mars, clay synthesis*

- Synthesized clays to create a reference dataset of spectral standards for Mars orbiters and rovers
- Analyzed results to determine implications for both remote sensing and in situ mineralogy

WORK EXPERIENCE

Valgo

Co-founder and CTO | Fall 2025-present | San Mateo, CA

Keywords: *safety validation, autonomy, risk estimation*

- Building tooling for algorithmic safety validation

Reliable Robotics

GNC Intern | Summer 2022 | Mountain View, CA

Keywords: *aircraft automation, machine learning, safety-critical system*

- Led implementation and analysis of **machine learning techniques** to support development of automated cargo aircraft
- Designed data collection procedures and set up model training and validation pipeline in Pytorch

MIT Lincoln Laboratory

Research Intern | Summer 2017/2018 | Boston, MA

Keywords: *aircraft collision avoidance, Markov decision process (MDP), safety-critical system, C++, Matlab*

- Supported testing of **Airborne Collision Avoidance System X (ACAS X)**
- Improved safety and decreased reversals in advisories for aircraft coordinating horizontal collision avoidance maneuvers by modifying **Markov decision process (MDP)** formulation
- Developed heuristic collision avoidance logic to test interoperability of ACAS X with other collision avoidance systems
- Integrated logic into C++/Matlab model for ACAS X simulations

Infoscitex, a DCS Company

Operations Analyst Intern | Spring 2017 | St. Louis, MO

Keywords: *sensor models, mission-level simulation*

- Worked with Advanced Framework for Simulation, Integration, and Modeling (AFSIM) performing mission level analysis applicable to the United States Air Force
- Developed sensor models for Advanced Air-to-Air Combat (A3C) simulations

Johns Hopkins University Applied Physics Laboratory

NASA Intern | Summer 2016 | Laurel, MD

Keywords: *GNC, satellite, Parker solar probe*

- Assisted with guidance and control for **NASA's Parker Solar Probe** mission (now in orbit around the sun)
- Enhanced solar illumination model for solar array control system analysis
- **Identified critical control system parameter change** to better manage arrays during momentum dumps

NASA Glenn Research Center

Summer Intern | Summer 2013-2015 | Cleveland, OH

Keywords: *design team, spacecraft concepts, trajectory optimization*

- Worked on the Collaborative Modeling for Parametric Assessment of Space Systems (COMPASS) design team to perform rapid integrated vehicle systems analyses
- Formulated and solved **trajectory optimization** problems for capturing a spacecraft into the Neptune/Triton system
- Updated the COMPASS database to allow customers and team members to understand trends in payload mass, dry mass, cost, power, etc., specifically in Solar Electric Propulsion (SEP) vehicles
- Developed **high temperature materials** (composites and aerogels) for use in both spacecraft and aircraft (2013)

LEADERSHIP AND TEACHING

Validation of Safety-Critical Systems

Stanford University | Winter 2025 | Stanford, CA

- Instructor for a new course that covers algorithms that can be used to ensure the safe operation of decision-making systems used in high-stakes settings
- Developed course materials such as lecture slides, programming assignments, and exercises
- Lecture videos are publicly available online

Teaching Assistant

Stanford University | Stanford, CA

- **Designing Robust and Reliable AI Systems** (Summer 2023): Assisted with the development and execution of a week-long course with the Stanford Center for Professional Development
- **Decision Making Under Uncertainty** (Winter 2023): class of over 450 students, managed programming assignments, held weekly office hours
- **Engineering Design Optimization** (Spring 2021): managed programming assignments, held weekly office hours, and gave lecture on gradient-based optimization
- **Building Trust in Autonomy** (Winter 2021): designed assignments and curriculum for undergraduate seminar

AI4ALL Mentor

Stanford University | Summer 2021/2023 | Stanford, CA

- **Led the robotics group and developed curriculum** for a three-week summer camp to introduce high school students from underrepresented backgrounds to AI concepts and topics

Outreach Videos

Stanford University | Stanford, CA

- **Stanford Intelligent Systems Laboratory:** producer for a documentary detailing the first ten years of the lab
- **Neural Network Verification:** created an introductory video on neural network verification
- **Markov Chain Monte Carlo:** intuitive explanation of Markov chain Monte Carlo in 10 minutes

Residential Peer Mentor

Washington University in St. Louis | Fall 2015 - Spring 2018 | St. Louis, MO

- Served as a resource for **150 calculus and physics students**, holding 6 office hours per week
- Conducted formal review sessions attended by 50-100 students before each major exam

Langsdorf Scholars Summit Co-Chair

Washington University in St. Louis | Fall 2017 - Spring 2018 | St. Louis, MO

- Proposed and executed idea to invite over 450 Langsdorf Scholar alumni back to Washington University campus for a weekend reunion and networking event
- Served as co-chair of the planning committee

Engineering Tutor and Course Grader

Washington University in St. Louis | Fall 2017 - Spring 2018 | St. Louis, MO

- Tutored individually for Electronic Circuits, Introductory Physics, and Signals and Systems
- Graded weekly quizzes for Engineering Electromagnetic Principles

Jump Rope Instructor

Spring 2015 - Spring 2018 | St. Louis, MO

- Started jump rope club at local St. Louis elementary school to share my knowledge of the sport of competitive jump rope
- Expanded club to include over 30 participants

FELLOWSHIPS

2020-2023 **National Science Foundation Graduate Research Fellow**
Three years of funding and support for graduate research

2018-2020 ***Stanford Graduate Research Fellow***
Initial funding and support during Master's degree

2014-2018 ***Langsdorf Fellow***
Full-tuition merit scholarship to attend Washington University in St. Louis

2014-2018 ***McKelvey Research Scholar***
Provided funds and support to perform undergraduate research at Washington University in St. Louis

HONORS AND AWARDS

2025 ***Stanford AIAA Excellence in Teaching Award***
For outstanding contributions in teaching (selected by students)

2021 ***Third Place in Student Research Competition***
Digital Avionics Systems Conference (DASC)

2021 ***Best Paper of Session***
Digital Avionics Systems Conference (DASC)

2019 ***Best Paper of Session***
Digital Avionics Systems Conference (DASC)

2018 ***Valedictorian***
Washington University in St. Louis School of Engineering and Applied Science

2018 ***David H. Levy Outstanding Senior Award***
Washington University in St. Louis Department of Electrical and Systems Engineering

2017 ***Russell R. Pfeiffer Outstanding Junior Award***
Washington University in St. Louis Department of Electrical and Systems Engineering

2017 **Outstanding Junior Leader Award Nominee**
Washington University in St. Louis

2017 **Tau Beta Pi**
Engineering Honor Society

2017 **Infoscitex Star Award**
For strong performance as an intern

2016 **Antoinette Francis Dames Award for Productive Scholarship in Engineering**
Washington University in St. Louis School of Engineering and Applied Science

2016 **Outstanding Sophomore Award**
Washington University in St. Louis Department of Electrical and Systems Engineering

2016 **Outstanding Sophomore Leader Award Nominee**
Washington University in St. Louis

INVITED TALKS

2025 **Offline POMDP Solutions**
AA228 Decision Making Under Uncertainty Guest Lecture (Stanford, CA)

2025 **AI Safety Webinar**
Stanford Online (Virtual)

2025 **How to Make Good Presentations**
TRex Bio (South San Francisco, CA)

2025 **How to Make Good Presentations**
Stanford Online (Stanford, CA)

2025 **Validation of Complex Decision-Making Systems**
Horasis Visionary Circle (Stanford, CA)

2025 **Verification and Validation of Safety-Critical Decision-Making Systems**
University of Auckland Space Institute Seminar (Auckland, NZ)

2025 **Building a Safety Case for AI in Aviation**
IEEE International Conference on Robotics and Automation Workshop (Atlanta, GA)

2025 **Multiobjective Optimization**
AA222 Engineering Design Optimization Guest Lecture (Stanford, CA)

2024 **Validation of AI Systems for Use in High-Stakes Settings**
CS120 Guest Lecture (Stanford, CA)

2024 **Validation of AI Systems for Use in High-Stakes Settings**
Amazon Lab126 (Sunnyvale, CA)

2024 **Safe Machine Learning-Based Perception and Open Problems in Scaling Formal Methods**
Dagstuhl Seminar 24361 (Wadern, Germany)

2024 **Algorithms for Validation**
Dagstuhl Seminar 24361 (Wadern, Germany)

2024 **Algorithms for Validation**
Stanford Center for AI Safety Annual Meeting (Stanford, CA)

2024 **Building a Safety Case for AI in Aviation**
GenAI x Aerospace Hackathon (Hillsborough, CA)

2023 **Safe Machine Learning-Based Perception via Closed-Loop Analysis**
AIAA Air Traffic Systems Webinar (Virtual)

2023 **Safe Machine Learning-Based Perception via Closed-Loop Analysis**
Sandbox AQ (Palo Alto, CA)

2023 **Efficient Determination of Safety Requirements for Perception Systems**
Digital Avionics Systems Conference (Barcelona, Spain)

2023 **Efficient Determination of Safety Requirements for Perception Systems**
NASA ULI Safe Aviation Autonomy Monthly Seminar (Virtual)

2023 **Safe Machine Learning-Based Perception via Closed-Loop Analysis**
Airbus Acubed (Sunnyvale, CA)

2022 **Verification and Validation of Safety-Critical Autonomous Systems**

Recent Advances in AI for National Security Conference (MIT Lincoln Laboratory, Boston, MA)

2022 ***Verification and Validation of AI Systems***
Reliable Robotics (Mountain View, CA)

2022 ***Operational Impact of Speed Change Advisories as Aircraft Collision Avoidance Maneuvers***
AIAA Aviation Forum (Virtual)

2022 ***Verification and Validation of Safety-Critical Autonomous Systems***
Trustworthy Autonomous Systems Governance Node (Edinburgh, Scotland)

2021 ***Generating Probabilistic Safety Guarantees for Neural Network Controllers***
NASA ULI Safe Aviation Autonomy Monthly Seminar (Virtual)

2021 ***Verification of Image-Based Neural Network Controllers using Generative Models***
Digital Avionics Systems Conference (San Antonio, TX)

2019 ***Learning an Urban Air Mobility Encounter Model from Expert Preferences***
Digital Avionics Systems Conference (San Diego, CA)

PUBLICATIONS

- Kochenderfer, M. J., **Katz**, **S. M.**, Corso, A. L., and Moss, R. J. *Algorithms for Validation*. MIT Press, 2026. URL: https://algorithmsbook.com/validation/files/val.pdf.
- Delecki, H., **Katz**, **S. M.**, and Kochenderfer, M. J. "Failure Probability Estimation for Black-Box Autonomous Systems using State-Dependent Importance Sampling Proposals". In: *International Conference on Control, Decision and Information Technologies (CODIT)*. 2025. URL: https://arxiv.org/abs/2412.02154.
- Valentin, R., **Katz**, **S. M.**, Vanhoucke, V., and Kochenderfer, M. J. "DB-KSVD: Scalable Alternating Optimization for Disentangling High-Dimensional Embedding Spaces". In: *ArXiv* 2505.18441 (2025). URL: https://arxiv.org/abs/2505.18441.
- Valentin, R., **Katz**, **S. M.**, Lee, J., Arief, M., Sorgenfrei, M., Walker, D., and Kochenderfer, M. J. "Uncertainty aware pose estimation and calibration from image features". In: *Digital Avionics Systems Conference (DASC)*. 2024.
- **Katz**, **S. M.** "Safe machine learning-based perception via closed-loop analysis". PhD thesis. Stanford University, 2023. URL: https://searchworks.stanford.edu/view/14781481.
- **Katz**, **S. M.**, Corso, A. L., Yel, E., and Kochenderfer, M. J. "Efficient determination of safety requirements for perception systems". In: *Digital Avionics Systems Conference (DASC)*. 2023. URL: https://arxiv.org/pdf/2307.01371.pdf.
- Rober, N., **Katz**, **S. M.**, Sidrane, C., Yel, E., Everett, M., Kochenderfer, M. J., and How, J. P. "Backward reachability analysis of neural feedback loops: Techniques for linear and nonlinear systems". In: *IEEE Open Journal of Control Systems* (2023), pp. 1–18. DOI: 10.1109/OJCSYS.2023.3265901.
- Smyers, E. Q., **Katz**, **S. M.**, Corso, A., and Kochenderfer, M. J. "AVOIDDS: Aircraft vision-based intruder detection dataset and simulator". In: *Advances in Neural Information Processing Systems (NeurIPS)*. 2023.
- Corso, A. L., **Katz**, **S. M.**, Innes, C. A., Du, X., Ramamoorthy, S., and Kochenderfer, M. J. "Risk-driven design of perception systems". In: *Advances in Neural Information Processing Systems (NeurIPS)*. 2022. URL: https://arxiv.org/pdf/2205.10677.pdf.
- **Katz**, **S. M.**, Alvarez, L. E., Owen, M., Wu, S., Brittain, M. W., Das, A., and Kochenderfer, M. J. "Collision risk and operational impact of speed change advisories as aircraft collision avoidance maneuvers". In: *AIAA AVIATION Forum*. 2022. DOI: 10.2514/6.2022-3824.
- **Katz**, **S. M.**, Corso, A. L., Strong, C. A., and Kochenderfer, M. J. "Verification of image-based neural network controllers using generative models". In: *Journal of Aerospace Information Systems* (2022). DOI: 10.2514/1.I011071. URL: https://arxiv.org/abs/2105.07091.
- Sidrane, C., **Katz**, **S. M.**, Corso, A. L., and Kochenderfer, M. J. "Verifying Inverse Model Neural Networks". In: *arXiv preprint arXiv:2202.02429* (2022). URL: https://arxiv.org/abs/2202.02429.
- Strong, C. A., **Katz**, **S. M.**, Corso, A. L., and Kochenderfer, M. J. "ZoPE: A fast optimizer for ReLU networks with low-dimensional inputs". In: *NASA Formal Methods Symposium (NFM)*. 2106.05325. 2022. URL: https://arxiv.org/abs/2106.05325.
- **Katz**, **S. M.**, Corso, A. L., Strong, C. A., and Kochenderfer, M. J. "Verification of image-based neural network controllers using generative models". In: *Digital Avionics Systems Conference (DASC)*. 2021. DOI: 10.1109/DASC52595.2021.9594360. URL: https://arxiv.org/pdf/2105.07091.pdf.
- **Katz**, **S. M.**, Julian, K. D., Strong, C. A., and Kochenderfer, M. J. "Generating probabilistic safety guarantees for neural network controllers". In: *Machine Learning* 2103.01203 (2021). DOI: 10.1007/s10994-021-06065-9. URL: https://arxiv.org/abs/2103.01203.
- **Katz**, **S. M.**, Maleki, A., Biyik, E., and Kochenderfer, M. J. "Preference-based learning of reward function features". In: *ArXiv* 2103.02727 (2021). URL: https://arxiv.org/abs/2103.02727.

• Weinert, A. J., Edwards, M., Alvarez, L., and **Katz**, **S. M.** “Representative Small UAS Trajectories for Encounter Modeling”. In: *AIAA Scitech 2020 Forum*. 2020, p. 0741.

• **Katz**, **S. M.**, LeBihan, A.-C., and Kochenderfer, M. J. “Learning an urban air mobility encounter model from expert preferences”. In: *Digital Avionics Systems Conference (DASC)*. 2019. DOI: 10.1109/DASC43569.2019.9081648. URL: https://arxiv.org/abs/1907.05575.

• Casanova, S., Henry de Frahan, J., Guimaraes Goecks, V., Herath, S., Herreras Martinez, M., Jamieson, N., Jones, T., Kang, S. W., **Katz**, **S. M.**, Li, G., et al. “Enabling deep space exploration with an in-space propellant depot supplied from lunar ice”. In: *AIAA SPACE and Astronautics Forum and Exposition*. 2017, p. 5376.

• **Katz**, **S. M.**, Nickerson, R. D., Ehlmann, B. L., and Catalano, J. G. “Synthesis and Analysis of Synthetic Smectite Clays for Use as Spectral Standards”. In: *Lunar and Planetary Science Conference*. 1903. 2016, p. 1683.

REVIEW ACTIVITIES

Journals

Journal of Artificial Intelligence Research
Journal of Aerospace Information Systems
IEEE Control Systems Letters
Journal of Air Transportation
Machine Learning Journal
Engineering Applications of Artificial Intelligence
IEEE Robotics and Automation Letters
IEEE Transactions on Automatic Control

Conferences

International Conference on Intelligent Robots and Systems (IROS)
American Control Conference (ACC)
Learning for Dynamics and Control (L4DC)
International Conference on Automation Science and Engineering (CASE)
Advanced in Neural Information Processing Systems (NeurIPS)