

Fangjun (Chloé) Zhu

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📄 chloezhu.org

🐙 [GitHub](#)

🌐 [Portfolio](#)

in [LinkedIn](#)

- Multidisciplinary education: M.S. in Physics, B.E. in Electrical & Computer Engineering, graduate research in pure Math and Robotics.
- Diverse professional experience: Semiconductor metrology and inspection systems, circuit analysis, design and troubleshooting, physical AI, neural networks, algorithms for inspection and calibration, motion control, computer vision, electronic and optical laboratory measurement, image sensors, system engineering, and with extensive cross-functional collaboration.
- Varied research experience: Geometric Analysis, Topology, Harmonic Analysis, Partial Differential Equations, Moduli Spaces of Riemannian Metrics, Computational Physics, Astronomy, Superconductivity, and Mathematical Foundation of Machine Learning.

Professional Experience

2024–present **Computer Vision System Design for Object Tracking from Drones**, *AI-Drone Technology LLC & Nanjing Robotics Institute*, Remote.

- Experimentally determined and programmed parameters for YOLO11 model object detection and tracking from drones in Python
- Configured the camera and captured video frames for AI mode fine-tuning and verification
- Developed a frame-level manipulation algorithm for single-object tracking amid homogeneous background objects

2023–2024 **Mask Qualification Algorithm Design of Teron 6xx Reticle Defect Inspection Systems**, *KLA Corporation, RAPID, Inspection*, Milpitas, CA.

- Designed, coded and implemented Python algorithms for detecting critical pattern and particle defects on EUV and DUV patterned reticles in mask shops on Linux based server
- Determined, extracted and compared key parameters for qualifying calchips' dicing process from pre- and post-inspection reports; established a dynamical threshold for categorizing defects through Python data visualization, thus corroborating the defect type, root cause and solution
- Pioneered optics and image processing enhancements to improve defect capture rate during reticle qualification, resulting in up to \$1M per year savings for the company

2022–2024 **Redesign, Remediation and Support of In Situ Deposition and Anneal UV Light Measurement System**, *KLA Corporation, Electronic Manufacturing Engineer, Sensarray, Metrology*, Milpitas, CA.

- Initiated and autonomously drove the project – Compensated for the system's optical variations by introducing Spectrally Weighted Responsivity. Established the new NIST-traceable, relative-irradiance calibration algorithm and procedures
- Experimentally prototyped, proofed and qualified the optical components of the system
- Led cross-functional team including guiding R&D engineers building data-driven solutions, in addition to leading electrical engineers on the hardware, mechanical engineers on the sensor assembly, and software engineers on the algorithm
- Promptly solved manufacturing and customers' recurring and varied urgent issues; maintained manufacturing and product lines
- Created data analysis and visualization interface using Python to locate, analyze, interpret and compare UV wafer lot performance over arbitrary time periods, establishing quantitatively reliable performance tracking system

- 2022–2024 **Manufacturing Design and Supervision of Circuits and Electronics**, *KLA Corporation, Electronic Manufacturing Engineer, Sensarray, Metrology, Milpitas, CA.*
- Performed functional testing, troubleshooting, and redesign for the circuits and the electronic components of wired instrumented wafer products, HighTemp Wafer Measurement Systems and plasma Etch Wafer Temperature Measurement Systems, and laid out associated flex circuits and PCBs
 - Analyzed, tested, and improved the RF communication module for product wafers; instituted analog integrated circuit failure statistics, investigated, and determined the root cause for each failure category based on those statistics
 - Contributed to the redesign of electronic test fixtures and test automation platforms
 - Advised external vendors on electronic part and module selection, incoming sub-assembly and assembly process issues and test solutions to ensure high yield
- 2022–2023 **Resolution of the In Situ Plasma Etch Wafer Temperature Measurement Systems Escalation**, *KLA Corporation, Electronic Manufacturing Engineer, Sensarray, Metrology, Milpitas, CA.*
- Discovered the root cause of major clients' nonuniform temperature distribution (hot spot issues); devised and conducted a physics-based heat flux experiment to assist in physically modeling wafers' thermal gradient and analyzed data
 - Resolved a mission-critical customer escalation on in-situ plasma etch wafer temperature measurement systems by efficiently analyzing thermo-IC sensors' response, sensor-attachment, and thermal-response issues
 - Developed Galil-based automated stage mapping for each sensor and streamlined the diagnostic process
 - Created the new key procedure that eliminated the mission-critical problems, resulting in significant improvement of customers' yield in plasma etch process
- 2022–2023 **Generic Testing System Development for TI MSP430 MCUs for Precise Real-time Temperature Tracing**, *KLA Corporation, Sensarray R&D, Metrology, Milpitas, CA.*
- Programmed SPI communication of common firmware used in testing any TI MSP430 series low-power microcontrollers; developed FTDI chip interface with the finite state machine controlled by LabVIEW
 - Analyzed and designed the RTL for the USCI Block in SPI mode, and determined the I/O line levels to control the transmit and receive state machines
 - Designed interface between the master-slave microcontrollers and finite state machine; adopted TortoiseSVN for version control

Research Experience

- 2024 **Mathematical Foundations of Machine Learning - Applied Geometry for Data Sciences**, *National University of Singapore, Institute for Mathematical Sciences, Singapore.*
- Engaged with developments in hyperbolic representation learning, geometric transformer architectures, and graph neural networks grounded in differential geometry and non-Euclidean metric spaces
 - Explored applications of harmonic analysis on graphs and manifolds, including Graph Fourier transforms, ridgelet transforms for deep networks, and spectral methods for structured data
 - Examined topology-driven frameworks for ML, including manifold sampling theory, geometric invariants, graph homomorphism-based expressiveness analysis, and topological approaches to virtual screening and network science
- 2024 **Interactions of Statistics and Geometry**, *National University of Singapore, Institute for Mathematical Sciences, Singapore.*

- Engaged with advanced topics in generalized and classical Fréchet means, asymptotic theory, and statistical analysis on manifolds and stratified spaces
 - Studied geometric central limit theorems on singular spaces, including phenomena of stickiness and smeariness in non-smooth geometric settings
 - Explored connections between geometric measure theory, asymptotics, and high-dimensional statistics, with emphasis on stability and limit behavior on stratified and singular spaces
- 2021–2022, **Independent Studies on Geometric Analysis**, *Northwestern University, Department of Mathematics*, Evanston, IL, USA & *Karlsruher Institut für Technologie (KIT), Institut für Algebra und Geometrie*, Karlsruhe, Baden-Württemberg, Germany.
- 2024–2025
- Conducted research on harmonic analysis in nonlinear PDEs, leveraging Hardy space–BMO duality, Calderón–Zygmund theory, maximal operators, and compensated compactness for the analysis of Ginzburg–Landau variational models [Presentation](#)
 - Conducted research in geometric analysis and nonlinear variational PDEs, analyzing energy-minimizing configurations of chiral skyrmions via topological degree methods and concentration–compactness arguments to establish existence of minimizers with nontrivial topological charge [Paper](#)
 - Conducted research in infinite-dimensional analysis and geometric functional analysis, studying translations of Gaussian measures on Wiener space and presenting a proof of the Cameron–Martin theorem in the context of the Segal–Bargmann representation of Fock space [Paper](#)
 - Investigated harmonic functions and parabolic PDEs, studying Laplace and heat equations via Green’s functions, heat kernel representations, and Harnack inequalities with connections to geometric analysis on Riemannian manifolds [Writing Sample](#)
 - Rigorously constructing non-perturbative ϕ^4 theory in low dimensions. Stratifying singular sets for the Landau–Ginzburg equations
 - Investigating the moduli spaces of Riemannian metrics and manifolds with special holonomy and Seiberg–Witten equations
 - Studied differential and symplectic geometry applied in nonlinear control theory, nonholonomic systems and nonlinear optimization
- 2020–2022 **Independent Studies on Topology**, *Northwestern University, Department of Mathematics*, Evanston, IL, USA & *University of Wisconsin-Madison, Department of Mathematics*, Madison, WI, USA.
- Exploring the applications of Hodge theory, perverse sheaves and $\mathcal{D}$ -modules to invariants of hypersurface complements [Presentation](#)
 - Investigating applications of topology to the classification of topological superconductors, and classifying $SU(2)$ -monopoles [Paper](#)
- 2020 **Astronomical Optics and Instrumentation**, *Northwestern University, Department of Physics and Astronomy*, Evanston, IL, USA.
- Studied shape memory alloys coated in magnetic smart materials using Olympus microscope; analyzed the power spectral density and characterized the optical system
 - Experimented on magnetic-smart shape memory alloys under Shack-Hartmann Wavefront Sensor system; studied the control of adaptive optics and deployable mirrors
 - Investigated wavefront aberrations using Zernike and Legendre polynomial fittings
- 2019–2020 **Astronomical Image Analysis and Computer Vision**, *Northwestern University, Department of Physics and Astronomy*, Evanston, IL, USA.
- Investigated the roughness of the Jupiter’s moons Io and Europa through the detection of the existence of the Arago spot from NASA PERIJOVE 22 images
 - Analyzed Io shadow images using computer vision techniques with Python for data analysis
 - Studied wavefront sensing techniques to improve Arago Spot detection precision
 - Created and submitted the proposal to NASA FINESST Fellowship
- 2019–2020 **Scintillating Bubble Chambers for the Direct Detection of Dark Matter**, *Northwestern University, Department of Physics and Astronomy*, Evanston, IL, USA.
- Designed the automatic control system and implemented it on the NI cFP-1808 using NI LabVIEW
 - Presented principles of optimization and control theory applied in high energy physics

- 2019 **Machine Vision and Neural Network Design for Electrical Switching Stations**, *Nanjing Robotics Institute, Nanjing Tech University*, Nanjing, China.
- Established the switching status inspection system based on OpenCV and mathematical morphological image processing under macOS environment
 - Developed an optical character recognition system based on EAST neural network and Tesseract recognition engine adopting LSTM neural network [GitHub](#)
- 2018–2019 **Independent Studies on Graph Theory and Image Segmentation Algorithm**, *Cognitive & Sensory Motor Control Lab, Nanjing Tech University*, Nanjing, China.
- Applied max-flow min-cut theorem to increase computational efficiency
 - Employed AI algorithms to time-series data on dam deformation monitoring in Geosciences, resulting in publication
- 2018 **CAS Key Laboratory of Geospace Environment**, *University of Science and Technology of China*, Hefei, China.
- Independently studied micro-pulse upconversion Doppler LIDAR and Polarized Laser Radar
 - Developed hands-on experience in optics lab by setting up Femtosecond Laser Radar experiments
- 2017 **NAO Humanoid Robot Golf Competition (2nd place)**, *Cognitive & Sensory Motor Control Lab, Nanjing Tech University*, Nantong, China.
- Developed a vision-guided control system for a NAO humanoid robot, integrating camera perception with autonomous motion behaviors
 - Designed a closed-loop control for pressure on Dobot multifunctional desktop robot arm using Force Sensitive Resistor (FSR)
 - Connected sensing, decision logic, and actuation in a modular pipeline for real-time target detection and robot navigation [GitHub](#)
- 2017 **Team Leader for Dobot Robotic Arm for Calligraphy**, *Cognitive & Sensory Motor Control Lab, Nanjing Tech University*, Nantong, China.
- Developed an end-to-end pipeline converting SVG/image stroke data into executable robot arm trajectories for autonomous calligraphy tasks
 - Implemented path parsing, coordinate normalization, computer vision, and stroke-to-motion mapping for precise Cartesian control [GitHub](#)
- 2017–2018 **Intelligent Instrumentation and Testing Group**, *College of Electrical Engineering and Control Science, Nanjing Tech University*, Nanjing, China.
- Independently studied Eddy Current Pulsed Thermography in Nondestructive Testing
 - Enhanced professional writing skills in Machine Learning algorithms (PCA Feature Extraction, Semi-Parametric Loglikelihood Criterion, SVM, various clustering methods, etc.) applied in NDT

Publications

Yin Xing, Jianping Yue, Chuang Chen, Fangjun Zhu, Kanglin Cong, and Dongjian Cai. Dam deformation forecasting avoiding social and environmental impacts caused by dam break. *FRESENIUS ENVIRONMENTAL BULLETIN*, 28(11 A):8831–8838, 2019.

Song Ding, Peizhen Shi, Ping Wang, Mengdi Li, Fangjun Zhu, and Dingyi Zhu. Influence of depth on eddy current pulsed thermography for rail crack detection. 2017.

Projects

- 2025 **The PyTorch Associate Training**, *The Linux Foundation, The PyTorch Foundation*, San Francisco, CA, USA.
- Honed the foundational and practical skills demonstrating mastery of PyTorch in the upcoming PyTorch Certified Associate exam
 - Strengthened ML/DL capabilities and hands-on experience, built and optimized real-world models from scratch
- 2024 **Digital Imaging Technology and Performance Metrology for Mobile Sensing**, *SPIE/IS&T Electronic Imaging Symposium*, San Francisco, CA, USA.

- Studied CMOS Image Sensors, 4T PPD, CDS, Rolling vs Global Shutter, ISP Pipeline and Characterization tests, PTC, Spatial vs Temporal Noise, QE, MTF, and Dark Current
 - Examined mobile camera imaging optics: Module Lens, Microlens and Color Filter Array
 - Developed Matlab programs for color demosaicing of Bayer images, reference detector calibration, power meter data acquisition and LED stability monitoring
- 2021 **Electromagnetic Eddy Currents of a Moving Conductor**, *Department of Physics and Astronomy, Northwestern University, Evanston, IL, USA.*
- Explored the usage of nondestructive testing in Comsol for the study of eddy currents
 - Simulated the EM field of a conductor moving with constant velocity with respect to a magnetic field
- 2020 **Computational Physics and Ergodic Theory in Dynamical Systems**, *Northwestern University, Department of Physics & Astronomy & Department of Mathematics, Evanston, IL, USA.*
- Analyzed the discrepancy of Mercury's precession rate due to neighboring planets and general relativity by Runge-Kutta methods using Jupyter Notebook
 - Numerically solved for the evolution of a double pendulum and simulated its motion [Github](#)
- 2019 **Machine Learning: Unsupervised Learning Project**, *Northwestern University, Department of Electrical and Computer Engineering, Evanston, IL, USA.*
- Built a collaborative filtering movie recommendation system
 - Developed a python GUI application by Tkinter [Github](#)
- 2019 **Analysis of Large Datasets of Large-Scale Cosmic Structures**, *Northwestern University, Department of Physics and Astronomy, Evanston, IL, USA.*
- Applied nearest neighborhood algorithm to classify void and Large Scale Structure (LSS)
 - Identified connected regions of void through an applied clustering algorithm based on density measure
 - Calculated the probability of a point being contained in a void via rejection sampling
 - Applied DBSCAN to identify the LSS, calculated the cluster, and used Voronoi diagrams to locate the voids in between the structure elements
- 2018–2019 **Building Electrical and intelligent Systems Design**, *Nanjing Institute of Architecture Design Co., Ltd, Nanjing, China.*
- Designed power supply and distribution systems, lighting systems and public security systems for intelligent buildings using AutoCAD
 - Applied electrical control technology of building to designing building equipment management systems and building information equipment systems
 - Studied the principles of building electrical engineering and designed the direct digital control system
 - Improved building intelligent environment, resulting in 20% less power consumption
- 2017 **Embedded System (STM32 ARM) Programming and Simulations**, *College of Electrical Engineering and Control Science, Nanjing Tech University, Nanjing, China.*
- Drafted and analyzed the STM32 Arm chip peripherals such as I/O ports, ADCs, Timers, DACs, SPIs, I2Cs and UARTs using ADS
 - Programmed the STM32F4xx chip peripherals using C and simulated its performance [GitHub](#)
- 2017–2018 **Studies and Designs in Control Systems and Optimization**, *College of Electrical Engineering and Control Science, Nanjing Tech University, Nanjing, China.*
- Investigated typical control systems' time and frequency domain responses and stability using Matlab
 - Designed and evaluated the control systems' stability via Routh-Hurwitz and Nyquist criteria and Bode plot using SIMULINK
- 2017–2018 **Power Electronics Design and Simulations**, *College of Electrical Engineering and Control Science, Nanjing Tech University, Nanjing, China.*
- Designed and tested power circuits such as DC-DC converter, rectifier and so on using oscilloscope, spectrum analyzer, etc. as analysis tools
 - Computed the conversion efficiency and analyzed the signals and systems
- 2017 **Electrical Machines Circuit Fabrication and Analysis**, *College of Electrical Engineering and Control Science, Nanjing Tech University, Nanjing, China.*
- Built circuits of electrical machines such as transformers, AC motors, induction motors and synchronous motors
 - Measured the voltage, power, and cosine of argument using oscilloscope
 - Plotted the measured parameters and analyzed each performance

- 2017 **Circuit Design, Simulations and Analysis**, *College of Electrical Engineering and Control Science, Nanjing Tech University*, Nanjing, China.
- Constructed and analyzed op-amp circuits, filters and harmonic circuits, using different connection networks and their transformations and conducted amplitude-argument and Fourier/Laplace/Z transform analyses
 - Designed and tested analog circuits and digital circuits using NI Multisim, and assembled (soldered) a complete multimeter
- 2016 **Robotics Engineer Summer Intern**, *KITA Technologies*, Nanjing, China.
- Programmed MCU in C for temperature, pressure alarming system and did 3D printing for medical robots
 - Practiced C++ programming of joint detection and movement tracing for applications to physical therapy and rehabilitation

Education

- 2021 **Former doctoral student, Robotics**, *Sorbonne Université Pierre and Marie Curie Campus, Institut des systèmes intelligents et de robotique (Institute of Intelligent Systems and Robotics)*, Paris, Île-de-France, France,
Research: Microrobots Optiques pour la Manipulation Interactive des Échantillons Biologiques.
[Presentation](#)
- 2021 **Graduate Researcher, Mathematics**, *Karlsruher Institut für Technologie (KIT), Institute of Algebra and Geometry*, Karlsruhe, Baden-Württemberg, Germany,
Research: Modulräume der Riemannschen Geometrie (Moduli Spaces of Riemannian Geometry).
- 2019–2021 **M.S. in Physics**, *Northwestern University, Department of Physics and Astronomy and Department of Mathematics*, Evanston, IL, USA, *GPA: 3.80/4.00.*
Relevant Coursework:
- Topics in Geometry; Topics in Dynamical Systems; Topics in Analysis: Harmonic Analysis
 - Abstract Algebra; Measure Theory; Complex Analysis; Topics in Physics: Principles of Symmetry (Lie Groups and Lie Algebras)
 - Introduction to Optimization; Graph Theory; Algebraic Topology
 - Classical Mechanics; Quantum Mechanics; Statistical Mechanics; Electrodynamics
- 2015–2019 **B.E. in Electrical and Computer Engineering, Summa Cum Laude (Top 3)**, *College of Electrical Engineering and Control Science, Nanjing Tech University*, Nanjing, China, *GPA: 3.81/4.00.*
Relevant Coursework:
- Advanced Mathematics; Linear Algebra; Probability and Statistics
 - Automatic Control Theory; Introduction to Automation (Cybernetics)
 - Programming in C/C++; MATLAB, Mathematica, SAS
 - Computer Architecture; Principles of Processors
 - Sensor Technology; Controller Technology; Network and Communication Technology
 - Circuit Analysis; Electronic Technology; Electric Machines; Power Electronics and Electric Drives
- 2017 **Visiting Student**, *Johns Hopkins University, Krieger School of Arts & Sciences and Whiting School of Engineering*, Baltimore, MD, USA, *GPA: 4.00/4.00.*
Relevant coursework:
- Subatomic World (Introduction to High Energy Physics)
 - Mathematics of Music

Honors & Awards

University First-Class Scholarship,

Fall Term 2018, Spring Term 2017, Spring Term 2016, Spring Term 2015.

University Individual Scholarship (Research Innovation),

Spring Term 2018.

University Second-Class Scholarship,

Fall Term 2017, Fall Term 2016, Fall Term 2015.

Second Prize at the 8th Jiangsu Province Robotic Competition,
November 2017.

Selected Conferences and Seminars

- 2025 **Team Member**, *Problem-solving Workshop: Computational Geometric Analysis*, National Science Foundation and CUNY Graduate Center, Department of Mathematics.
Computational methods in geometric analysis, minimal surfaces and geometric modeling, polynomial systems and algebraic computation, and Lie theory and representation computations
- 2022 **Guest**, *NSF Workshop on matrix factorizations and related topics*, University of Notre Dame.
Matrix factorizations and their connections to commutative algebra, derived categories and physics.
- 2021 **Guest**, *Workshop on Curvature and Global Shape*, Westfälische Wilhelms-Universität Münster.
Manifolds with special holonomy, moduli spaces of Einstein metrics, Ricci flow and Kähler-Ricci flow, stability, rigidity and symmetry of metrics satisfying curvature conditions
- 2021 **Speaker**, *PDE Seminar: Existence of Chiral Skyrmions*, RWTH Aachen University, Department of Mathematics, Aachen, Nordrhein-Westfalen, Germany.
 - Characterized the non-trivial topological charges that minimize energy
 - Applied Lions' concentration-compactness theorem in order to obtain existence for minimizers
- 2021 **Speaker**, *Topology Seminar*, Northwestern University, Department of Mathematics, Evanston, IL, USA.
 - Applied the long exact sequence in homotopy to path space and loop space
 - Constructed classifying spaces for compact Lie groups
- 2021 **Guest**, *The 35th Annual Geometry Festival*, Stony Brook University, Simons Center for Geometry and Physics & Department of Mathematics, Stony Brook, NY, USA.
 - Explored research topics such as the Kähler Ricci flow, mirror symmetry and Gromov-Witten invariants with guidance from Prof. Jean-Pierre Demailly, Prof. Tristan Collins and other experts.
 - Learned of open problems in the theory of manifolds with special holonomy from Prof. Simon Donaldson.
- 2021 **Speaker**, *Dynamical System Seminar: Applications of Ergodic Theory to Number Theory and Combinatorics*, Northwestern University, Department of Mathematics, Evanston, IL, USA.
 - Proved partition regularity of piecewise syndetic sets
 - Used Ramsey's theorem to demonstrate the existence of infinite subcollections of almost independent events
- 2021 **Speaker**, *Gauge Field Theory*, Northwestern University, Department of Physics and Astronomy, Evanston, USA.
 - Estimated the potential in radial gauge by field strength
 - Established existence of Coulomb gauge for both electrodynamics and chromodynamics
- 2020 **Speaker**, *Measure Theory Seminar*, Northwestern University, Department of Mathematics, Evanston, IL, USA.
 - Proved the Steinhaus theorem on the distance sets in one dimension
 - Explored Falconer's distance set conjecture

Teaching Assistantships

- 2021 **Physics 136 General Physics Laboratory - Modern Physics**, *Northwestern University, Department of Physics and Astronomy.*

Skills

- **Software tools/languages:** C (Certified), C++, Python, MATLAB, Mathematica, Image Processing (Certified), Signal Processing (Certified), JMP, COMSOL, Cadence, AutoCAD, LaTeX, SAS, PLC, Microsoft Office Advanced (Certified), VB (Certified), ADS, OrCAD, NI Multism, PSpice, PyTorch, Snowflake Cortex

- **Quantitative research:** Circuit Analysis, Design and Troubleshooting, Schematics, PCB/flex layout, Electronic and Optical Laboratory Measurement, Automated Testing, Partial Differential Equations (PDEs), Harmonic Analysis, Image Sensor Metrology, Physical Modeling, Statistical Analysis, Optics, Computer Vision, Robotics and Intelligent Systems
- **Communication:** English, Chinese, German, Japanese

Instrumentation

- **Electrical:** Oscilloscopes, Spectrum Analyzers, Function Generators, Source Meters, Wafer Probers, Wire-bonders, Thermistors/thermocouples/RTDs, 3D Printers, DMMs
- **Optical:** Photodiodes, CMOS Sensors, Lenses, Fibers, Filters, Diffusers, Lamps, Lasers, LEDs, Spectrometers, Monochromators, Microscopes, Telescopes, Wavefront Sensing, Adaptive Optics, Imaging Optics, Cameras