

Christopher Culbreath

Physicist · Educator · Programmer · Machinist

Adaptable physicist with a passion for innovation and collaboration. Skilled in problem-solving and communication across domains such as education, materials research, automation, optics and imaging systems, prototyping, and fabrication. Seeking opportunities to contribute to creative projects that challenge and inspire.

----- MULTIDISCIPLINARY SKILLS AND EXPERTISE -----

- * Designing experiments and performing analysis to characterize and iterate product development
- * Design and fabrication of mechanical parts through CAD, CAM, and prototype machining
- * Selecting sensors for data measurement, acquisition, analysis, and quantifying uncertainty
- * Optimizing data analysis pipelines using tools such as Mathematica, MATLAB, and open-source Python libraries
- * Programming rich, interactive data visualizations
- * Communicating technical ideas to both technical and non-technical audiences with strong technical writing and engaging presentations
- * Multi-disciplinary expertise in soft-matter condensed physics, optics, and mechanics

----- PROFESSIONAL EXPERIENCE -----

California Polytechnic University | San Luis Obispo, California

September 2016 - June 2024

Senior Lecturer, Physics Department

- * Taught as many as 120 undergraduate engineers and scientists each quarter with an engaging, evidence-based curriculum
- * Infused lectures on theoretical concepts of mechanics, waves, optics, thermodynamics, electricity, and magnetism with real-world applications and spirited commentary to ensure knowledge retention and student success
- * Built and expanded research programs investigating novel shape-memory materials while simultaneously teaching courses and supervising student researchers
- * Developed, refined, and implemented Physics Cloud, a bespoke web application for the assignment and collection of online assignments and distribution of assignment scores and course grades

NRD LLC (formerly Nuance Designs) | San Luis Obispo, California

April 2019 - December 2021

Materials Science and Automation Engineer

- * Researched, discovered, and implemented theoretical models and simulations of thermodynamic properties for an auto-injector prototype using a novel liquid-vapor equilibrium propellant
- * Earned executive leadership buy-in for a proposal that brought Elastium Technologies together with NRD on a contractual basis for continued development of a single-crystal shape memory furnace
- * Acted as a key contributor in scaling and refining processes for production and commercial sale
- * Performed system-level testing and evaluations to ensure functional and performance readiness of developed prototypes and products

Elastium Technologies | Emeryville, California

March 2017 - September 2018

Materials Science and Automation Consultant

- * Onboarded to develop an automation control scheme for a newly developed single-crystal shape memory continuous casting furnace
- * Chosen by leadership to stay on as a consultant after the automation project ended
- * Revamped and turned around ineffective processes using novel techniques, resulting in improved productivity and higher efficiency
- * Developed a comprehensive automation control scheme that incorporated electrical and embedded system elements for the single-crystal shape memory continuous casting furnace
- * Contributed to system design improvements focused on increased productivity and higher efficiency in the continuous casting furnace

- * Led lectures and taught calculus-based mechanics for up to 200 students
- * Fostered an enthusiastic and positive class culture to facilitate active learning
- * Engaged students with original and memorable lab exercises and in-class demonstrations
- * Piloted a summer research program investigating twist disclinations in nematic liquid crystals

MacSuperstore | San Luis Obispo, California

August 2005 - June 2008

Senior Technician

- * Earned certification as an Apple Desktop and Portable Repair Technician
- * Highest scoring participant in Apple Online Training for 2007 among all US resellers
- * Performed front counter troubleshooting, diagnosis, while-you-wait and full-service repairs
- * Performed hardware and software repairs on Apple desktops, portables, and iPods
- * Earned highest metrics in efficiency, productivity, and repair quality, doubling the number of completed repairs per technician

Iconic Photography | Kent, Ohio

March 2011 - January 2015

Owner, Photographer, Client Satisfaction Expert

----- EDUCATION -----

2015 | Doctor of Philosophy - Chemical Physics | Liquid Crystal Institute, Kent State University

2008 | Bachelor of Science - Physics | California Polytechnic State University San Luis Obispo

2006 | Apprentice Machinist | Sherburne Sculptures, Atascadero, California

----- LANGUAGES AND FRAMEWORKS -----



----- PERSONAL PROJECTS AND HOBBIES -----

[Software Development] *Physics Cloud*: A custom learning management system built on the LAMP stack. *Chore Cloud*: Brings family chores and allowance tracking to mobile devices. *Physics Cloud Résumé*: Delivers a native macOS experience for tracking, preparing, and submitting job applications. *Mom's Bills*: A multi-device, FileMaker-based relational database accounting platform. [Precision Machining] *Classically Trained* by a master machinist in conventional machining methods. *Combining creativity with quality* bringing innovation to fabrication and artistry to my creative work. [Electronics Projects] *Nine-Digit Nixie-Tube Timer*: Commemorated the final 104,185,920 seconds before my dad's retirement. *Kite Aerial Photography*: Provided a unique vantage point before drones, using a custom-built RC rig. *Three-Axis CNC Mill*: Built as an invaluable introduction to motion control. *Drumline Robot*: (in progress) Combines o-drive, brushless motors, and advanced robotics to deliver the sound of a marching band from a bike trailer. [Photography & Print] *My creative voice* blends traditional methods like letterpress, silk screen, and darkroom printing with *advanced technical skills* in desktop publishing and photography.

----- PUBLICATIONS -----

- * Long, C., Deutsch, M. J., Angelo, J., Culbreath, C., Yokoyama, H., Selinger, J. V., Selinger, R. L. B.. "Frank-Read Mechanism in Nematic Liquid Crystals"↗ Phys. Rev. X, 14(1),(2024).
- * Angelo, J., Culbreath, C., Yokoyama, H.. "Breaking planar liquid crystal anchoring to form controllable twist disclination loops"↗ Molecular Crystals and Liquid Crystals, 646(1),(2017).
- * Glazar, N., Culbreath, C., Li, Y., Yokoyama, H.. "Switchable liquid-crystal phase-shift mask for super-resolution photolithography based on Pancharatnam-Berry phase"↗ Applied Physics Express, 8(11),(2015).
- * Christopher Culbreath. "Artificial Microscopic Structures in Nematic Liquid Crystals Created by Patterned Photoalignment and Controlled Confinement: Instrumentation, Fabrication, and Characterization"↗ Kent State University. Doctoral Dissertation. (2015)
- * Culbreath, C., Glazar, N., Yokoyama, H.. "Automated maskless micro-multidomain photoalignment"↗ Review of Scientific Instruments, 82(12),(2011).

----- FOR PROJECT PHOTOS, RESEARCH PAPERS, AND MORE, VISIT CULBREATH.NET↗ -----