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

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California State University | Chico, California **January 2015 - June 2016**

Lecturer, Physics Department

* 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).

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