Keith Krenek

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SUMMARY

Senior Technical Staff and applied physicist (PhD) building reliable, interpretable algorithms state estimation, photonics, and biomed. At Draper (2019–now) I deliver production-ready dynamical models, Kalman/Bayesian estimation, and physics-ML systems that fuse real-world sensors for mission-critical navigation and biomedical platforms. Results include >90% radiation-performance prediction accuracy, ~100× design-cycle reductions, and validated specifications for FOG navigation.

CORE SKILLS

State Estimation Control

Kalman Filtering & Bayesian Inference, Model Identification & Validation, Particle Filters & Monte Carlo, Navigation Systems & Requirements, Sensor Fusion & Uncertainty Quantification

Biomedical Systems

Physiologic Signal Processing, Biosensor Integration (CMOS, Microfluidics), Real-time Data Acquisition & Control, Cell/Particle Analysis & Morphology Tracking, Medical Device Development & Validation

ML/Hybrid Modeling

Physics-Informed ML, Hybrid Models for Time-Series, Computer Vision for Microscopy & Medical Imaging, Production MLOps & Automated Retraining

Tech Leadership

AI/ML Team Leadership (4+ engineers), Mentoring & Technical Direction, Cross-functional Collaboration & Stakeholder Alignment, Documentation & Validation Protocols

WORK EXPERIENCE

Senior Technical Staff - Sensors & Imaging Systems @ Draper Lab

Oct 2019 – now — Cambridge, MA

- Developed navigation algorithms and error models for mission-critical gyroscopes and accelerometers; implemented Kalman/Bayesian state estimation to evaluate accuracy in harsh environments.
- Built physics-ML model for radiation-exposed optical fiber manufacturing; >90% predictive accuracy avoided program delays and reduced costs.
- Authored radiation-hardness assurance framework (non-central t-distributions, tolerance factors) to define program specifications.
- Designed multiphysics optimization platform across 5+ coupled domains (electrical, mechanical, fluidic, thermal, acoustic) to optimize microfluidics device design and operation.
- Led a 4-engineer team delivering physics-informed generative-design tools for photonics ICs; ~100× faster design cycles without sacrificing optical performance.
- Shipped computer-vision pipeline for microfluidic cell tracking, reconstructing 3D trajectories from 2D microscopy.

Python | MATLAB | COMSOL Multiphysics | Kalman/Bayesian Estimation | Monte Carlo | OpenCV

Research Staff — Advanced Imaging Systems @ MIT Lincoln Lab

2013 – 2018 (Summers + part-time) — Lexington, MA

- Engineered vision-guided automated electrical probe platform for photodiode arrays with sub-μm precision and autonomous operation (zero damage incidents).
- Designed and executed radiation-effects testing establishing performance bounds and qualification criteria for deep-space optical communications sensors.
- Developed closed-loop controls and real-time error detection for microfabrication processes, improving repeatability and yield stability.

Computer Vision | Precision Motion Control | Automation/Test Systems | Radiation Testing | Signal Processing

PhD Researcher @ Harvard University - Donhee Ham Research Group

Sep 2015 - Jul 2019 — Cambridge, MA

- Pioneered CMOS-integrated bioelectronic platform for high-density neural recording (4096 channels), spanning process development, packaging, and signal processing.
- Invented novel nanopipette-electrode process for CMOS biointerfaces, leading complete R&D cycle from concept to validated manufacturing method.
- Published 3+ peer-reviewed papers (Nature BME, IEEE JSSC); filed patent on electronic circuits for electrogenic cell analysis.

CMOS Integration | Bioelectronics | Microfluidics | Signal Processing | Nanofabrication | Electrochemical Analysis

Graduate Researcher @ Texas A&M University - NanoBio Systems Lab

Aug 2013 - May 2015 — College Station, TX

- Built automated cell-morphology analysis system; ~10× throughput improvement via computer vision with time-series tracking and population statistics.
- Designed/fabricated 100+ custom microfluidic devices with validation protocols and QC standards.
- Developed CMOS-microfluidics integration platform with automated fluid control and real-time data acquisition.

Computer Vision | MATLAB | Microfluidic Design | Automated Analysis | Time-Series Analysis | Statistical Validation

SELECTED PROJECTS

Machine Learning for Radiation-Hardened Optical Fiber Manufacturing

Production physics-ML system predicting radiation performance using engineered features and ensemble models; integrated automated retraining and SPC.

Approach: High-Dimensional Data Analysis; Ensemble Modeling; Feature Engineering; Automated Retraining; Statistical Process Control

Impact: Avoided schedule slip; >90% prediction accuracy; sustained multi-year production guidance.

Methods: High-Dimensional Data Analysis, Ensemble Modeling, Feature Engineering, Automated Retraining, Statistical Process Control

FOG Navigation Accuracy Simulation & Requirements

End-to-end simulation of FOG navigation performance with environmental factors, drift, and error propagation; translated findings into requirements and validation criteria.

Approach: Kalman/Bayesian Estimation; Monte Carlo; Uncertainty Quantification; System Modeling

Impact: Established performance specifications and acceptance tests for mission-profile scenarios; reduced technical risk.

Methods: Kalman/Bayesian Estimation, Monte Carlo, Uncertainty Quantification, System Modeling

Automated Cell Tracking in Microfluidic Devices

Automated CV pipeline converting 2D microscopy into 3D particle/cell trajectories with physics-informed reconstruction and force/velocity readouts.

Approach: Object Detection/Tracking; Physics-Informed Reconstruction; Real-time Processing; Statistical Validation

Impact: Quantified acoustic-manipulation effects for immunotherapy workflows; improved study reproducibility.

Methods: Object Detection/Tracking, Physics-Informed Reconstruction, Real-time Processing, Statistical Validation

PUBLICATIONS

A nanoelectrode array for obtaining intracellular recordings from thousands of connected neurons — *Nature Biomedical Engineering* (2020)
10.1038/s41551-019-0455-7

The design of a CMOS nanoelectrode array with 4096 current-clamp/voltage-clamp amplifiers — *IEEE Journal of Solid-State Circuits* (2020)

EDUCATION

Ph.D. in Applied Physics Jul 2019

Harvard University — Cambridge, MA

GPA: 3.57/4.00

Thesis: Leveraging CMOS technologies in neuronal studies

M.S. in Electrical Engineering May 2015

Texas A&M University — College Station, TX

GPA: 4.00/4.00

Thesis: High-throughput microfluidic acoustic system to generate yeast cells for aging studies

B.S. in Electrical Engineering (Mathematics Minor) May 2014

Texas A&M University — College Station, TX

GPA: 4.00/4.00

Honors: Summa Cum Laude, University Honors, Engineering Scholars

AWARDS & RECOGNITION

- Analog Devices Outstanding Student Designer Award
- Harvard Distinction in Teaching Award
- Lockheed Martin Excellent Participation Award
- NSF Graduate Research Fellowship

LEADERSHIP & MENTORING

- Draper Lab Mentor Program

- Harvard SEAS Summer Intern Supervisor
- Team Lead - Photonics generative design tools
- Graduate Student Mentor