Nathan R. Cao

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Education

- **Rice University** *August 2023 - May 2027*
  B.S. Electrical and Computer Engineering, GPA: 3.89/4.00 Houston, TX
  - Activities: Neurotech@Rice (2023 - 2025 Officer), Rice University Cycling and Triathlon team member
  - Relevant coursework: Analog Circuits, Signal Processing, Semiconductor Devices, Machine Learning, Biomedical Imaging, Digital Logic Design, Probability Theory, Biosensors, Algorithms and Discrete Math
  - Teaching: Calculus 1, 2, and 3 tutor (August 2024 - August 2025). Signals and Systems Course Assistant (August 2024 - Present). Mentored 200+ students in office hours, hosted exam review sessions.

Selected Projects

- **Real-time Monitoring Sweat-based Lactate Biosensor** *September 2025 - December 2025*
  - Calibrated a Prussian Blue electrochemical lactate sensor by performing cyclic voltammetry, chronoamperometry, and LOx enzyme immobilization; validated performance using CHI660F potentiostat and standard-addition measurements.
  - Fabricated multilayer PET/Kapton microfluidic devices and screen-printed electrodes, laser-cut channels, and conducted on-body sweat monitoring while capturing real-time amperometric data
- **FPGA Implementation of RISC 16-bit Processor** *September 2025 - December 2025*
  - Designed and integrated a 16-bit processor in Verilog, combining ALU, decoder, branch logic, regfile, PC, and custom instruction/data memory using Icarus Verilog on Linux cluster
  - Synthesized and deployed the design onto a Xilinx Spartan-7 FPGA using Vivado, validating hardware execution by running multi-program instruction memory tests
- **Analog Audio Spectrum Analyzer** *October 2024 - May 2025*
  - Implemented multi-stage analog bandpass filters (OpAmps, resistors, etc.), used LTSpice simulations and VNA to tune cutoff frequencies; characterized input audio using DMMs, and oscilloscopes
  - Developed a full PCB version in KiCad, creating schematic and board layouts; assembled and soldered the finalized boards and verified audio visualization from computer input
- **Resnet-18 Convolution Neural Network Audio Emotion Classifier** *March 2025 - May 2025*
  - Built a full audio-emotion classificatier by preprocessing speech clips (bandpass filtering, MFCC + Mel-spectrogram extraction, PSD analysis) and training an RBF-kernel SVM with GridSearchCV-optimized hyperparameters, achieving 80% accuracy on the private test set.
  - Designed and trained a modified ResNet-18 CNN on normalized single-channel Mel-spectrograms (dropout, AdamW weight decay), comparing different feature combinations, reporting 70% accuracy

Work Experience

- **The University of Texas MD Anderson Cancer Center** *August 2025 - Present*
  Undergraduate Researcher (Advised by Dr. Jeffrey H. Siewerdsen) Houston, TX
  - Apply spectral-domain DSP (zero-padding, FIR/IIR filtering, matched filtering) in MATLAB for CT 3D–2D image projection, accelerated computation (Linear Algebra, running on the GPU - CUDA)
- **NSF REU Boston University Photonics Center** *June 2025 - August 2025*
  Undergraduate Researcher (Advised by Dr. Tianyu Wang); Grant EEC-2349173 Boston, MA
  - Self-taught ANSYS Zemax. Configured open-source optical and electromagnetic simulations mimicking Zemax, created ray-tracing models. Utilized Git version control and Github to document progress.
  - Generate optimization algorithms (brute force, gradient-based, genetic algorithm) for the automatic tuning of optical component parameters, accelerated computation through CPU threading

Publications, Posters, and Talks

[1]] Zhou L., et al. (including Cao N.) (2025). **FACFNet: Missing Modalities Brain Tumor Segmentation with Cross-modal Feature Interaction and Frequency-Domain Enhancement**. *IEEE JBHO* (Under review)

[2]] Cao N., et al. (August 7, 2025). **Towards Fully Automated Beam Alignment for Optical Experiment Setups**. Presented at *Boston University Photonics Center Undergraduate Research Poster Symposium*.

Skills

- **Software skills:** MATLAB (DSP toolbox, kWave), Python, Java, Verilog, Javascript, C, C++, Github, Version Control, ANSYS Zemax, Power BI, Microsoft Suite, SolidWorks
- **Hardware skills:** KiCAD, LTspice, Breadboarding, FPGA implementation, analog/digital signal processing, oscilloscope, DMM, VNA, waveform generator, Vivado, OpAmps