

AARON EARLE-RICHARDSON

Neural Signal Processing & BCI Engineer

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HIGHLIGHTS OF QUALIFICATIONS

- 7+ years scientific Python with deep PyTorch expertise; hand-written CUDA C kernels (CuPy RawKernel); SQL (SQLite); C/C++, MATLAB, Bash; contributor to MNE-Python (merged PR).
- Maintainer of **iEEG_Pipelines**, an open-source, GPU-accelerated iEEG/ECoG analysis package (pip-installable as *iieeg*) with CI/CD and code review on every pull request, used inside and outside the Cogan Lab.
- First-author BCI paper in preparation: PyTorch tensor-decomposition decoder for speech-prosthesis development. Presented at SfN (2022, 2023, 2024), AAAS (2025), CNS (2024), Duke TBS (2022, 2023).
- Data infrastructure lead for a clinical neuroscience lab operating inside an FDA-regulated research environment: own the de-identification, data-integrity, and reproducibility layer of an active investigational uECoG study (up to 1024-channel arrays) under IDE and IRB oversight; led the lab-wide migration from MATLAB/Windows to Python/Linux/BIDS.
- Data engineering across the stack: BIDS/NWB/DANDI standards, PHI removal, SQLite schema design with additive migrations, ETL pipelines, HPC (SLURM) and AWS, GitHub Actions CI/CD.
- Medical-device design-controls exposure: on a six-person Duke team building an academic Design History File per 21 CFR 820.30 for a patented Class II junctional tourniquet, personally owned the ISO 14971 Design FMECA (40+ failure modes) and a 164-standard applicability database (18 SDOs). MEng BME + Medical Device Design Certificate (Duke); BS Bioengineering (Cornell).

PROFESSIONAL EXPERIENCE

Scientific Data Manager I - Duke Department of Neurology (Cogan Lab)

Jan 2025 – June 2026

Lead data infrastructure for a clinical neuroscience lab conducting research under FDA Investigational Device Exemption (IDE) and Duke IRB oversight, collaborating with the Viventi Lab on high-density uECoG investigational neural arrays (up to 1024 channels) used intraoperatively at Duke University Medical Center. Author and version-control the lab's analysis pipelines; maintain BIDS-standard data systems with PHI removal for NWB/DANDI compliance. Migrated the lab from MATLAB/Windows to a Python/Linux stack with cloud-deployable scripts, managing a live clinical pipeline cutover; CI caught a numpy 2.0 ABI break and a silent mne-bids regression before they reached collaborators. Public lab GitHub: github.com/coganlab. Supervisor: Greg Cogan, PhD.

Research Technician II - Duke Department of Neurology (Cogan Lab)

Apr 2021 - Dec 2024

Converted Cogan Lab data systems to the BIDS standard with PHI removal for NWB/DANDI compliance. Created new ECoG/iEEG analysis pipelines (Python/BIDS). Led the infrastructure transition from MATLAB/Windows to Python/Linux. Supported cross-functional intracranial neural recording collaborations across Duke Neurology, Neurosurgery, and the Viventi Lab.

Lab Technician - Cornell Psychology Department

May 2019 - Dec 2019

Built an AWS-deployed fMRI preprocessing server for Cornell's functional MRI research data using the BIDS format. Integrated FSL, AFNI, FreeSurfer, and ME-ICA via Python Nipype with multi-threaded Python and Bash. Supervisor: Khenia Swallow, PhD.

Research Assistant - Cornell Psychology Department

Jan 2017 - May 2019

Recruited and surveyed participants per experimental design. Identified a study design flaw that led to significant protocol changes. Supported an fMRI study measuring activity in the Locus Coeruleus. Supervisor: Khenia Swallow, PhD.

Data Analyst (Internship) - Boston Children's Hospital

May 2018 - Jan 2019

Center for Pain and the Brain. Analyzed MRI and DTI data using MATLAB and Bash to predict demyelination and other neurodegeneration in pediatric patients. Applied machine learning to predict spinal disease pathogenesis. Conducted patient chart reviews for retrospective studies. Supervisor: Nadia Barakat, PhD.

APPLIED PROJECTS

Full list: [linkedin.com/in/aaron-earle-richardson-781747184](https://www.linkedin.com/in/aaron-earle-richardson-781747184) (Projects)

Neural Sub-Processes Linking Speech Perception and Production

Nov 2021 - present

First-author paper in preparation. PyTorch-based decoder applying unsupervised tensor decomposition (sliceTCA, forked and extended from Pellegrino et al.) to iEEG recordings from epilepsy, movement disorder, and tumor patients undergoing pre-surgical intracranial monitoring at Duke. Identifies latent neural sub-processes bridging speech perception and production without imposing a priori anatomical bias; supports speech-prosthesis BCI development. CUDA-accelerated.

iEEG_Pipelines (open-source toolkit)

Jul 2021 - present

Open-source iEEG/ECoG analysis stack for the Cogan Lab: BIDS conversion, PHI removal for NWB/DANDI compliance, GPU-accelerated signal processing (hand-written CUDA kernels via CuPy RawKernel), GitHub Actions CI/CD, pip-installable as *iieeg*. Docs: iieeg-pipelines.readthedocs.io

Jobs Crawler (open-source, personal)

2026 - present

Job-search crawler integrating ten ATS APIs (Greenhouse, Lever, Ashby, Workday, and others) with thread-pooled fetching, an LLM-assisted company-discovery pipeline, resume-fit scoring via the Claude API, and browser-capture ingestion of gated job boards.

SQLite persistence layer designed from scratch: normalized companies/jobs schema, additive idempotent migrations, upsert semantics, ranked join queries. Public: github.com/Aaronearlerichardson/Jobs

Junctional Tourniquet (PATs) - Patented Class II Medical Device

Jan 2021 - Feb 2022

Academic design-controls project: co-developed a pneumatic junctional tourniquet for traumatic axillary and inguinal hemorrhage on a six-person Duke engineering team building an academic Design History File per 21 CFR 820.30. Personally owned the ISO 14971 Design FMECA (40+ failure modes) and the applicable-standards database (164 standards, 18 SDOs, each mapped with applicability rationale); contributed to four-predicate 510(k) analysis (CRoC, SAM Junctional, JETT, AAJT) and reliability-based verification sample sizing, with executed pressure and strap-failure testing. Patented; 2nd place, Innovate Carolina 2021; presented to the Chairman of the Joint Chiefs of Staff.

EEG Earbud Biometric Authentication System

Jan 2018 - Jan 2021

Led a team building an in-ear EEG device for personal identification (Cornell capstone): MATLAB ML classifier, later deep neural networks for motion-artifact rejection. First project-management role.

CMRIF_Preprocess

May 2019 - Dec 2019

Cornell fMRI preprocessing pipeline (BIDS, multi-threaded Python, Bash, FSL/AFNI/FreeSurfer/ME-ICA).
github.com/Aaronearlerichardson/CMRIF_preprocess

Earlier projects

2018 - 2019

Object-oriented Python neuron simulation (github.com/Aaronearlerichardson/Neuron_sim); chemical reaction-pathway calculator using depth-first search (github.com/Shaumik-Ashraf/BiosystemsProject).

POSTERS & PAPERS

Earle-Richardson, A. M., Duraivel, K., Southwell, D., Sinha, S., Vestal, M., Grant, G., Zafar, M., & Cogan, G. B. Neural sub-processes linking speech perception and production. (In preparation.) Presented as posters at the Society for Neuroscience (2022–2024) and Duke TBS Research Symposium (2022–2023).

Sexton, D. P., Earle-Richardson, A. M., Southwell, D. G., Vestal, M., & Cogan, G. B. Decoding verbal working memory load from intracranial high gamma activity. AAAS, 2025.

Zhang, J., Earle-Richardson, A. M., Southwell, D., Frauscher, B., Egner, T., & Cogan, G. B. Intracranial EEG correlates of concurrent demands on cognitive stability and flexibility. Society for Neuroscience, 2024; Cognitive Neuroscience Society, 2024.

Earle-Richardson, A. M., Barakat, N. Exploration of methods in medical image data analysis. Cornell Bioengineering Conference, 2019.

EDUCATION

Duke University, Pratt School of Engineering - Durham, NC

Jan 2021 - May 2022

Master of Engineering, Biomedical Engineering; Medical Device Design Certificate

Cornell University - Ithaca, NY

Sept 2016 - May 2019

Bachelor of Science, Bioengineering (College of Agriculture and Life Sciences)

George Washington University - Washington, DC

Sept 2015 - May 2016

Transferred

TECHNICAL SKILLS

- **Programming:** Python (PyTorch, NumPy, SciPy, pandas, MNE-Python, Nipype), CUDA (hand-written C kernels via CuPy RawKernel), SQL (SQLite: schema design, migrations, joins), C/C++, MATLAB, Bash/Shell, JavaScript, HTML/Liquid, Git
- **ML & Signal Processing:** iEEG/ECOG/EEG, fMRI/DTI, GPU-accelerated tensor methods, unsupervised decomposition, machine learning, statistics
- **Data Engineering:** BIDS, NWB/DANDI, PHI de-identification, ETL pipelines, SQLite persistence design, reproducibility and versioning, LLM-assisted tooling (Claude API)
- **Platforms:** Linux, AWS, Duke Compute Cluster (SLURM), GitHub Actions CI/CD, GitHub Pages, ReadTheDocs, virtual machines (VirtualBox, WSL)
- **Hardware & Design:** Fusion 360, SolidWorks, 3D printing, prototype test-rig development
- **Quality & Regulatory:** Design Controls (21 CFR 820.30), DHF, ISO 14971 FMECA, predicate-based 510(k) strategy, IEC 62366, ISO 10993 documentation review, ISO 13485 familiarity, FDA QMSR transition awareness; GCP-adjacent experience (investigational device research under IDE/IRB)
- **Languages:** English (native), French (conversational), Spanish (beginner)

REFERENCES

Greg Cogan, PhD - Gregory.cogan@duke.edu

Khena Swallow, PhD - kms424@cornell.edu