Duc Vu

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Education

Michigan State University   *East Lansing, MI*

BACHELOR OF SCIENCE IN COMPUTER ENGINEERING   *Aug 2022 - May 2026*

Honors: Dean's List, Honors College, EnSURE Scholar, Professorial Assistantship

Research Experience

Signal Processing Lab, Michigan State University   *East Lansing, MI*

NSF-FUNDED UNDERGRADUATE RESEARCH ASSISTANT – PROF. SELIN AVIYENTE   *May 2024 – Present*

- Led research projects in collaboration with faculty and PhD students; contributed to results generation, manuscript writing, and figure creation.
- Developed a scalable processing pipeline using SLURM, AWS S3, MRtrix3, and FreeSurfer to analyze structural connectomes from 122 HCP subjects.
- Designed and implemented a novel hypergraph construction method from fMRI data to uncover overlapping communities in brain networks.

Semantic Signals Lab, Carnegie Mellon University   *Pittsburgh, PA*

SUMMER RESEARCH INTERN – PROF. JUSTIN CHAN   *May 2025 – July 2025*

- Ran user studies with over 30 total participants; built motion artifact removal and classification pipelines for depth-based eye gestures.
- Engineered a heart-sound collection system using repurposed earbud speakers and fitted adapters for in-ear monitoring.
- Built VR simulations using Meta Quest 2 and hardware prototypes like auto-adjustable focus glasses for potential applications.

Signal Processing Lab, Michigan State University   *East Lansing, MI*

PROFESSORIAL ASSISTANT – PROF. SELIN AVIYENTE   *Aug 2022 – May 2024*

- Supported research on Graph Signal Processing (GSP) and Graph Neural Networks (GNN) through algorithm design and empirical validation.
- Built graph filter optimization algorithms in MATLAB and applied them to EEG datasets across 20 participants.
- Configured and maintained Python environments, assisting with PyTorch, MNE, and PyGSP setup for lab members.

Publications

ACCEPTED

Ortiz-Bouza, M.*, **Vu, D.***, Karaaslanli, A., Aviyente, S. (2025). Learning Graph Filters for Structure-Function Coupling based Hub Node Identification. *IEEE Transactions on Signal and Information Processing over Networks*, 2025. doi:10.1109/TSIPN.2025.3595070 (*Equal Contribution)

- Processed fMRI and DWI data from 122 subjects in the Human Connectome Project (HCP), downloaded via AWS S3 and used FreeSurfer with MRtrix3 to construct both structural connectomes and fMRI time-series signals.
- Implemented and evaluated a learning-based graph filter framework alongside conventional machine learning models to generate hubnode results.
- Proposed a novel hyperparameter selection strategy based on cross-method result consistency and validated hub nodes based on global efficiency metrics.

- Parcellated connectomes to Glasser atlas (360-region) and mapped results to Yeo functional networks for inter-atlas comparison and performed consistency analysis using entropy-based metrics.
- Co-wrote the manuscript and contributed to the design, analysis, and presentation of results.

Vu, D., Aviyente, S. (2025). Hypergraph Overlapping Community Detection for Brain Networks. *arXiv preprint arXiv:2507.08999*.

- Proposed a hypergraph-based overlapping community detection method for fMRI-derived brain networks.
- Suggested validating detected communities by aligning with known ICA-derived networks and assessing consistency through randomized network scoring.
- Led the project from idea to experimentation and result generation.
- Coordinated research direction and wrote the majority of the manuscript.

Vu, D., Ortiz-Bouza, M., Aviyente, S. (2024). Graph Filtering for Hub Node Identification in Brain Networks. *2024 IEEE International Symposium on Biomedical Imaging (ISBI)*, 1–5. doi:10.1109/ISBI56570.2024.10635215

- Adapted and optimized a learnable graph filter framework in MATLAB for application on EEG-derived brain networks.
- Applied the framework and conventional algorithms such as One-Class SVM and Eigenvector Centrality to EEG data from 20 patients, generating comparative results.
- Proposed a validation strategy using percentage of hub nodes in each region and analyzing temporal significance of hub node activity.

In Review

Zhang, X.*, **Vu, D.***, Shen, C., Wang, Y., Shi, Y., Chan, J. (2025). VergeIO: Depth-Aware Eye Interaction on Glasses. *arXiv preprint arXiv:2507.02187*. (*Equal Contribution)

- Developed a motion artifact detection system; conducted false-positive analysis and proposed preamble gestures (e.g., eyebrow raise) and adaptive filtering for noise suppression.
- Co-wrote the manuscript and created the majority of the figures for analysis and publication.
- Led power consumption profiling using the Monsoon Power Monitor and conducted latency measurements with the Teensy 4.1 microcontroller.
- Designed hardware prototypes like auto-adjustable focus glasses and stereoscopic displays for real-world applications.

In Preparation

Zhang, S.*, Zhang, X.*, **Vu, D.***, Qiang, T., Palacios, C., Zhu, J., Wang, Y., Goel, M., Chan, J. (2025). LubDubDecoder: Bringing Micro-Mechanical Cardiac Monitoring to All Hearables. (*Equal Contribution)

- Co-wrote the manuscript in preparation for submission to CHI 2026.
- Designed and implemented an in-ear high-SNR heartbeat detection system using microphones and speaker-turned-microphone configurations, amplified via the Babyface Pro FS interface; developed real-time MATLAB feedback tools for troubleshooting and signal monitoring.
- Conducted a user study across 60 sessions with 24 participants to collect physiological data and survey responses.

Technical Skills

- **Languages:** Python, C++, C, MATLAB, LaTeX, Verilog
- **Developer Tools:** Git, HPC clusters, CLion, MATLAB, AWS, Jupyter Notebook, Linux, Unity, Arduino
- **Libraries:** pandas, Matplotlib, TensorFlow, Tensor Toolbox, PyTorch, NetworkX, FreeSurfer, MRtrix3, Nilearn
- **Others:** Krita, Photoshop, Vietnamese