CALVIN A. PERUMALLA, PH.D.

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PROFESSIONAL SUMMARY

Signal Processing Engineer and applied ML researcher with a PhD in Electrical Engineering and 8+ years building production-grade pipelines for multi-modal biomedical sensor data (video, EEG, pressure/force). Deep hands-on experience with FIR/IIR filtering, spectral analysis (FFT), feature extraction, and time-series modeling (CNN/LSTM). Proficient in Python's scientific stack (NumPy, SciPy, Pandas, scikit-learn, Matplotlib), PyTorch, and TensorFlow; comfortable in Jupyter and MATLAB. Proven collaborator with hardware/software engineers and clinicians; led sensor system design, integration, and rigorous validation in clinical and simulated environments.

SKILLS

- Signal processing: FIR/IIR filtering, FFT-based spectral analysis, feature extraction, time-frequency analysis, adaptive filtering (MMSE), PCA
- Machine learning: CNNs, LSTMs, activity recognition, anomaly detection, SVMs, Random Forests, Logistic Regression, clustering (HDBSCAN, k-means)
- Python: NumPy, SciPy, Pandas, scikit-learn, Matplotlib, Jupyter Notebooks
- Deep learning: PyTorch, TensorFlow
- Data engineering: SQL, PySpark, SparkML, Databricks
- Tools: MATLAB, C++, AWS, Git
- Domains: Biomedical signal processing (ECG, EEG), surgical video analytics, wearable/pressure sensing, ultrasound force mapping
- Software engineering: Production ML pipelines, unit testing, performance validation, experiment tracking
- Collaboration: Cross-functional work with HW/SW engineers and clinical teams; design/peer reviews; technical communication

RELEVANT WORK EXPERIENCE

Postdoctoral Researcher — Department of Surgery, Stanford School of Medicine, Stanford, CA (Feb 2021–Present)

- Designed end-to-end signal processing and machine learning pipelines to extract physiological and performance signatures from multi-modal data (surgical video, EEG, wearable/pressure sensors).

- Built CNN+LSTM models for surgical activity recognition, accurately detecting basic maneuvers (knot-tying, suture throws, cutting) and achieving state-of-the-art gesture detection for performance assessment.
- Developed EEG time-series processing (artifact mitigation, feature engineering, sequence modeling) and LSTM-based classifiers to differentiate high/low performance purely from EEG signals.
- Led design and integration of fabric-based piezo-resistive pressure sensing systems and data acquisition for scoliosis brace force mapping; executed successful pilot with 10+ patients.
- Collaborated with engineering labs to prototype conformable, acoustically transparent pressure sensor arrays for ultrasound force mapping; conducted phantom experiments establishing force ranges and variance across skill levels.
- Performed rigorous algorithm validation and benchmarking, including cross-validation, ablations, and error analysis; produced novel datasets to support ongoing research.
- Stack: Python (NumPy, SciPy, Pandas, scikit-learn, Matplotlib), PyTorch/TensorFlow, Jupyter, MATLAB; version control and experiment tracking.

Co-Principal Investigator — Stanford Catalyst Program, Stanford, CA (Apr 2024–Present)

- Core team member for a novel sensor-based system to assess surgeons in the operating room; contributed to technical strategy, validation plans, and system integration.
- Secured $350K seed funding; coordinated cross-functional R&D and milestone delivery.

Data Scientist — Vectra (Vectra AI), San Jose, CA (Oct 2017–Mar 2020)

- Built high-performance data pipelines (SQL, PySpark, SparkML) to curate and process >1B-row datasets in distributed environments (Databricks).
- Individually designed and implemented production ML models for anomaly detection (DNS exfiltration via volume/entropy features; DCE-RPC threat detection using collaborative filtering), reducing analyst workload by ~80%.
- Owned model validation, monitoring, and software architecture in high-throughput systems; collaborated closely with platform and product teams for deployment.

Ph.D. Research Assistant — iWin Lab, Electrical Engineering, University of South Florida, Tampa, FL (Jan 2013–Aug 2017)

- Developed predictive analytics for long-term ECG: engineered time-domain and spectral features; trained neural networks and SVMs to predict paroxysmal atrial fibrillation (PAF) from 24-hour ECG (≈20 GB), achieving >99% prediction accuracy.
- Built diagnostic classifiers for heart conditions from long-term ECG, achieving 98% accuracy with neural networks.
- Co-developed a continuous wireless Integrated Vectorcardiogram (iVCG) monitor; applied MMSE/least-squares optimization to transform to 12-lead ECG with <6% error and self-tracking algorithms with <5% error.
- Explored deep learning for wireless applications: LSTM-based user mobility prediction from large-scale vehicular data achieving 95% accuracy for future base-station connections.
- Tools: Python, MATLAB; methods: filtering, spectral analysis, adaptive signal processing, optimization.

EDUCATION

Ph.D., Electrical Engineering — University of South Florida, Tampa, FL (May 2017)

- Dissertation: Machine learning and adaptive signal processing techniques for electrocardiographic applications.

M.S., Electrical Engineering — University of South Florida, Tampa, FL (May 2014)

B.Tech., Electronics and Communication — Malla Reddy Engineering College (JNTU), Hyderabad, India (May 2011)

SELECTED ACHIEVEMENTS

- Achieved state-of-the-art performance in surgical gesture detection from video using CNN+LSTM architectures.
- Led design and pilot of wearable pressure-sensing system for scoliosis brace force mapping with 10+ patients.
- Developed EEG-based performance assessment models collected from 70+ OR cases and 120+ simulation cases.
- Reduced SOC analyst workload by ~80% via novel anomaly detection models deployed to production (Vectra AI).
- Predicted paroxysmal atrial fibrillation with >99% accuracy from 24-hour ECG; heart condition classification at 98% accuracy.

- Optimized wireless iVCG system achieving <6% transformation error to 12-lead ECG and <5% self-tracking error.
- Co-PI securing $350K seed funding (Stanford Catalyst Program) for sensor-based OR assessment system.
- 2 granted U.S. patents (iVCG system; AF prediction) and multiple peer-reviewed publications (14 total).
- 2021 Holman finalist for best paper (podium presentation); Member, National Academy of Inventors (USF Chapter).