

Title:

Wearable gas-sensing for early detection of prosthetic limb injuries

Description:

Soft-tissue injuries within prosthetic sockets often go undetected until they become painful and debilitating. This project investigates a wearable sensing approach that monitors gaseous biomarkers associated with tissue damage and infection (e.g., volatile compounds from blood and sweat) to enable early detection and intervention.

Using already built hardware for in-socket gas sensing, the project will conduct structured data collection across controlled activities and environmental conditions, followed by development of an AI model to identify and categorize injury types from multi-sensor time-series signals. Insights from this work will inform future miniaturization of the most promising sensors for seamless integration into advanced prosthetic hardware.

The selected student will have the opportunity to work on the following:

- Experimental design and protocol development for safe, ethical data collection with current wearable hardware (participant consent, de-identification, and IRB/REB alignment)
- Sensor calibration, drift/temperature/humidity compensation, and repeatability testing
- Dataset construction and labeling (ground truth from clinician notes, images, or participant logs)
- Signal processing and feature engineering for gas-sensor time series (denoising, windowing, spectral/temporal features)
- AI model development and evaluation (classical ML and deep learning), with class-imbalance handling and cross-validation
- Model interpretability (e.g., SHAP) and robustness testing across users, activities, and environments
- Edge-readiness assessment (latency, memory, power) and a roadmap for on-device inference in future embedded prototypes
- Technical documentation and a miniaturization plan for sensor selection, packaging, and integration with prosthetic control systems

This project offers a path from real-world data to clinically relevant detection algorithms, advancing safer, more comfortable prosthetic use through proactive injury monitoring.

Research Area: Wearable Sensing, Biomedical Engineering, Machine Learning, Human Factors, Embedded Systems

Start Date: Fall or Winter 2025

Application: Please submit your CV and a single paragraph describing your interest in the project in one file within a single email to