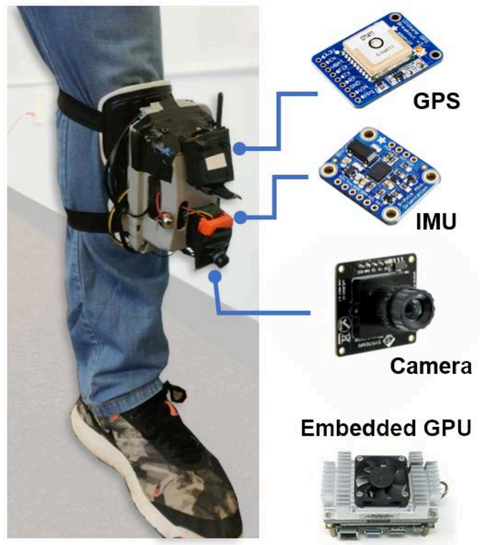
CAREER: Data Representation and Modeling for Unleashing the Potential of Multi-Modal Wearable Sensing Systems

Edgar Lobaton, North Carolina State University
https://research.ece.ncsu.edu/aros/wearable-sensing/

System Overview



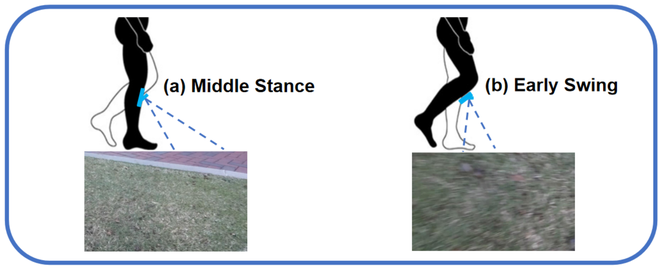
The project aims to develop methodology for the estimation and prediction of physiological responses and behavior. The framework builds on tools from statistical analysis, topological data analysis, optimization theory and human behavior analysis. This poster focuses on intent detection for wearable robotics even though other applications are also been considered.

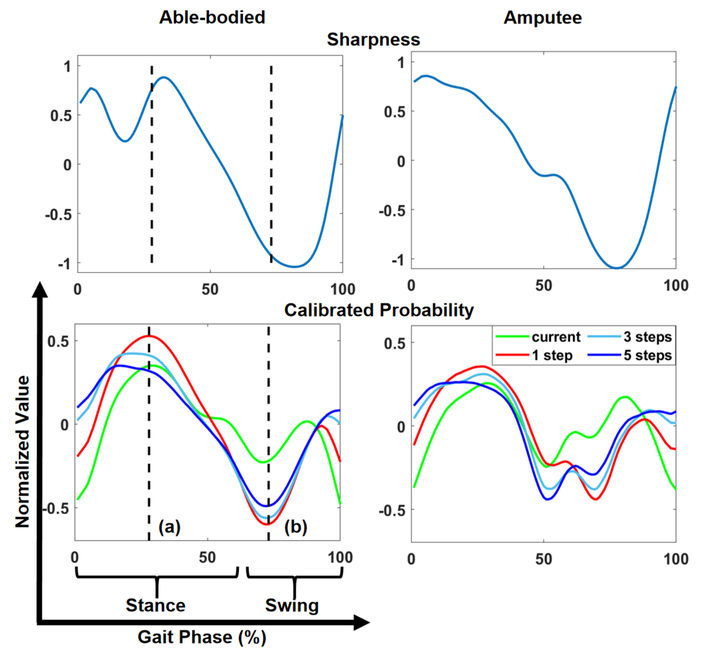
Key Challenges:

- Sensor fusion (including visual sensing) for lower limb wearable prosthetic
- Uncertainty quantification to safe estimation and operation
- Real-time and reliable execution

Scientific Impact:

- The methodology provide a good calibrated probably of correctness.
- We can use the uncertainty to drive sampling strategies in order to ensure real-time and reliable performance.

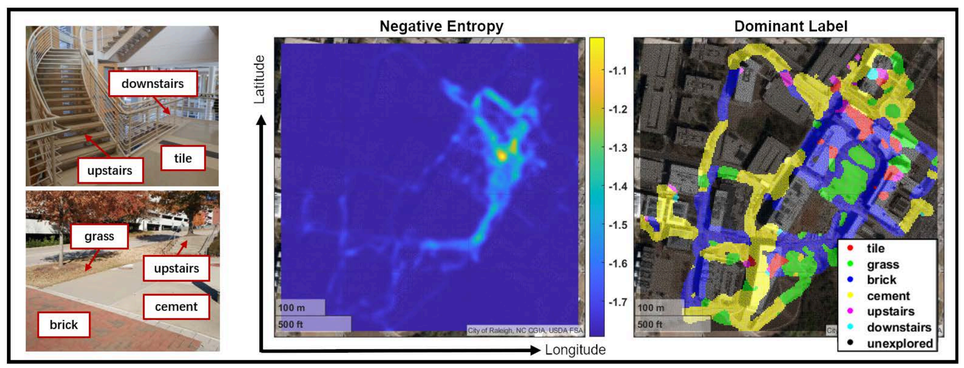




Approach:

- Bayesian Neural Networks for uncertainty quantification which gives a well calibrated probability of correctness for safety guarantees
- Uncertainty tell us when to sample in the phase and what cycles to skip
- Performance between able-bodied individuals and amputees is compared.

Data Collection Overview



Societal Impact: This work has a broad range of applications for wearable robotics with a particular emphasis on lower-limb amputees.

Education and Outreach: Data from this project have been used for course activities. Demos have been organized for several outreach events. There have been news release on this topic.

Broder Impact: Methodologies can be extended to other medical CPS (e.g., for robust prediction of cardiac or respiratory conditions)

2021 NSF Cyber-Physical Systems Principal Investigators' Meeting
June 2-4, 2021

Award ID#: 1552828