Nanopore Sensors and Algorithms
William Kendall, REU Student, Arizona State University
Graduate Mentor: Uday Shankar Shanthamallu, Faculty Advisor: Drs. Goryll, Spanias, Thornton
SenSIP Center, School of ECEE, Arizona State University

ABSTRACT

• Develop nanoscale ion channel sensor
• Implement machine learning algorithms to increase classification, specificity, and sensitivity

MOTIVATION

• Detect biochemical agents i.e. Anthrax
• Observe analytes at the single molecule level

PROBLEM STATEMENT

• Difficult to distinguish between features and artifacts
• Consistently forming lipid bilayers requires lots of preparatory work
• Inserting the desired amount of ion channels into the bilayer reliably is a challenge

EXPERIMENTAL METHODS: SENSORS

• Generate simulated ion channel data and use Power Spectral Density (PSD) based feature extraction
• Matrix completion with low rank assumption improves classification compared to using features directly
• Transform domain feature extraction and dwell time analysis
• Wavelet decomposition and the Discrete Wavelet Transform

EXPERIMENTAL METHODS: SENSORS

Original Signal

Denoised Signal

Current (pA)

Time (min)

A) OmpF

Exterior

OM

Periplasm

B) Biological pores

alpha-hemolysin

Internal Loop

Surface Loop

Beta sheet

PRELIMINARY RESULTS

Current (pA)

Time (min)

Single Ion Channel Classification

• PSD based feature extraction successfully classified simulated ion channel signals with an analyte present and signals without an analyte present

CONCLUSIONS

• Denoising with wavelets can be achieved
• Modest success with clustering, additional training required
• Experiments with other machine learning algorithms
• Testing noisy sequences required
• Ion channel array simulations are planned

REFERENCES


ACKNOWLEDGEMENT

This project was funded in part by the National Science Foundation, award number 1659871.