Analysis of Biomolecules Using a Novel Sapphire-supported Nanopore

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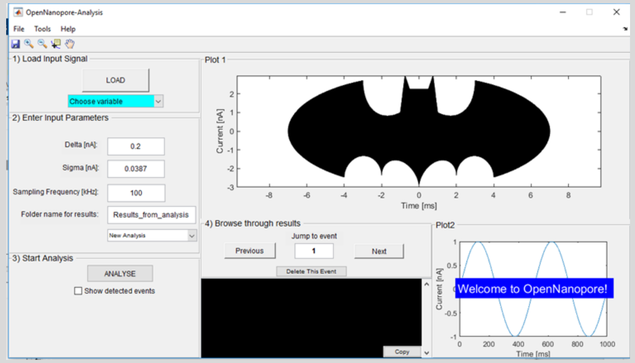
Introduction

- The research question this projects seeks to address is how the sensitivity of the solid-state nanopore can be improved for better detection of DNA strands.
- This project aims to improve and automate parts of the OpenNanopore software used to read and analyze the data from the nanopores in order to streamline data analysis.

Background

- Nanopores are often created naturally to aid many biological processes, but in 1996, Deamer and Branton became the first to use a nanopore to analyze DNA [1]
- Usually, solid state nanopore sensors are grown on Si substrates using semiconductor microfabrication techniques [1]
  - These Si-supported nanopores are effective, but the analysis results come back with significant capacitive noise which also limits their sensing accuracy and speed
  - This project aims to improve analysis with sapphire-supported nanopores which have much less capacitance and current noise [2]

OpenNanopore Analysis

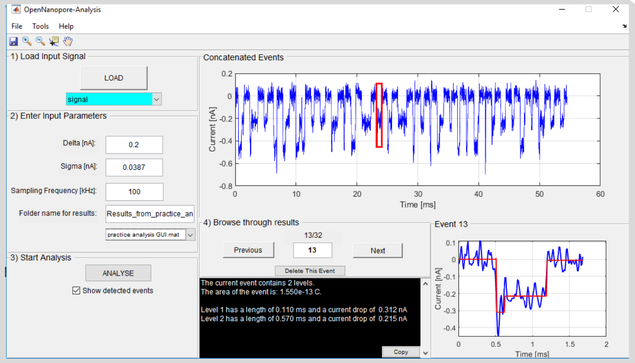


Starting Screen:

- .mat signal files collected from nanopores are loaded here
- Delta, sigma and sampling frequency are specified before analysis

After Analysis:

- The full signal is produced
- Data points are iteratively cycled through and bad points are manually removed to produce the final DNA event



Current Progress

- Running test analysis of various signal data with OpenNanopore software
- In order to streamline the data analysis, the MATLAB code is being edited to automatically concatenate multiple signal files into one for more efficient analysis

Future Work

- As the work progresses, this project aims to develop machine learning techniques that will allow a computer to read the signals and perform the analysis itself
- Future applications of this research include better biomarker detectors and possibly even the creation of DNA-based storage systems capable of storing secure data

	Spring 2021	Summer 2021	Fall 2021/Beyond
Task 1	Continue using OpenNanopore to run analyses	Further increase the autonomy of uploading in the OpenNanopore software	Continue working on machine learning strategies
Task 2	Develop code to automate uploading signals and doing analysis in OpenNanopore	Study machine learning techniques to create a method for the software to cycle through signal data autonomously	Investigate the applications of the signal data in technology

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References

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2. Xia, P., Zuo, J., Paudel, P., Choi, S., Chen, X., Song, W., … Wang, C. (2020). Sapphire-Supported Nanopores for Low-Noise DNA Sensing. BioRxiv, 2020.03.02.973826. https://doi.org/10.1101/2020.03.02.973826

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