Project Description

Title: Testing High Density, Flexible Electrodes for Treatment of Epilepsy
Student: Andrew Hicks
Advisor: Dr. Brian Litt

An important step in preventing epileptic seizures is to be able to identify the areas of a patient's brain affected during the seizure. Andrew sought to develop software to control high-density flexible electrodes, which would provide physicians with real-time monitoring of brain-seizure activity. This technology, which Andrew was able to demonstrate by using a pig's heart, can also monitor heart rhythms for patients with serious heart arrhythmias.

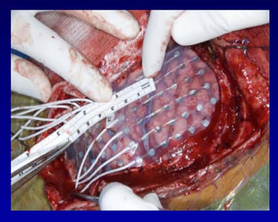
Testing High Density, Flexible Electrodes for Treatment of Epilepsy

Andrew Hicks
BE 490/492 - S2009/F2009

Advised by: Brian Litt, M.D.
Department of Bioengineering

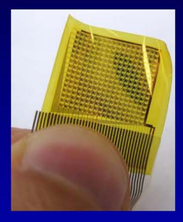
Background: Localizing Epileptic Tissue

Current State of the Art



- Large contacts
- Spaced far apart
- Individually wired
- Does not conform well

Next Generation



- 288 tiny electrodes
- 800 μm spacing
- 36 wires
- Flexible material

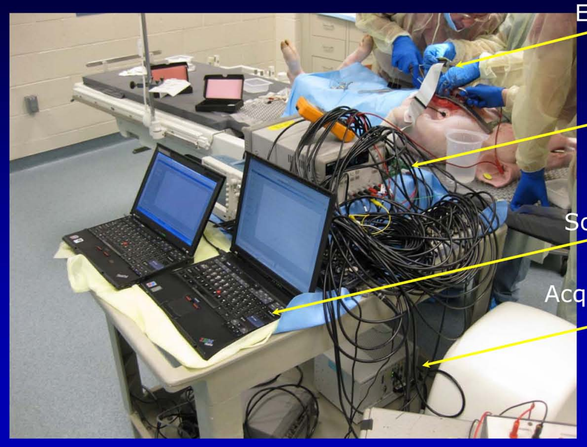
Objective: Control Data Acquisition

Build software in MATLAB to control data acquisition system

- Multiplex and demultiplex signal
- Provide real time visualization
- Control experimental parameters
  - Acquisition channels, sampling rate, etc.
- Synchronize analog input and output
- Impart long term recording stability

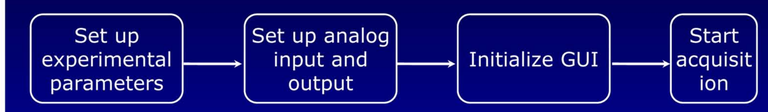
Data Acquisition Card

Data Acquisition System

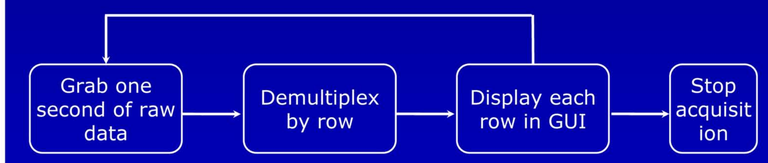


Software Block Diagram

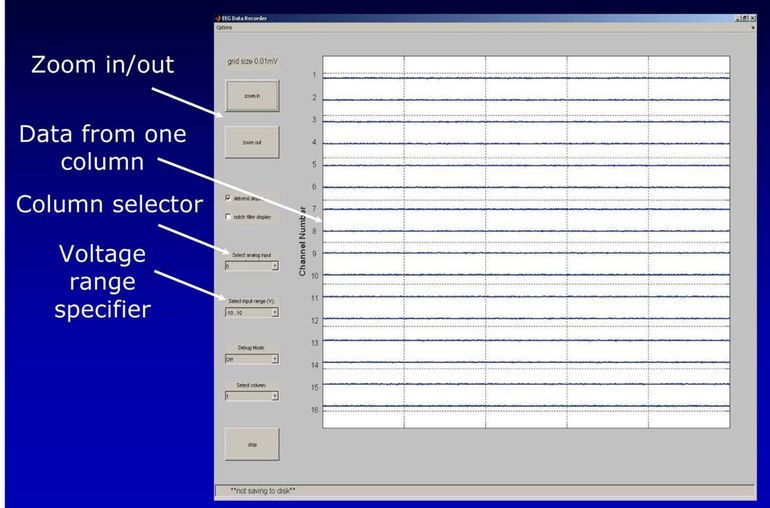
Phase I: Configure Hardware



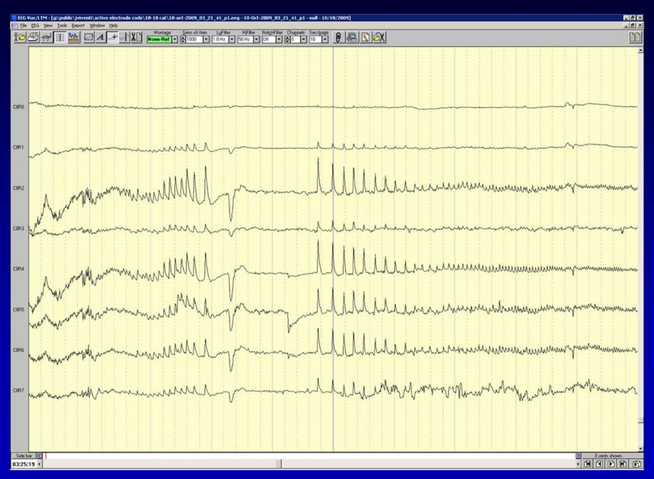
Phase II: Process and Display Data



Results: GUI for Acquisition

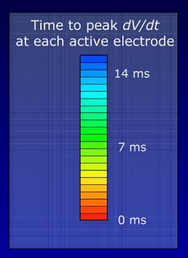


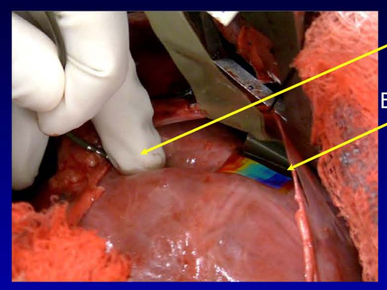
Results: Neural Data Acquisition



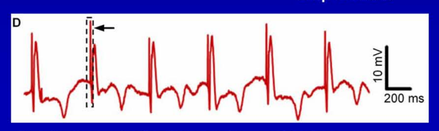
Possible sleep spindles recorded during cat experiment

Results: Cardiac Data Acquisition





Pig cardiac tissue depolarizes relative to distance from pacing as expected



Black arrow indicates pacing artifact as expected

Single voltage trace recorded during above experiment

Conclusions

- Future Directions
  - Add cardiac stimulation functionality
  - Migrate to LabVIEW for digital input/output control
  - Add advanced multiplexing for higher density electrode arrays

- Acknowledgements
  - Jonathan Viventi
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  - David Callans, M.D.
  - Jeffrey Keating, PhD