# Employing EEG Devices for Safety Improvement

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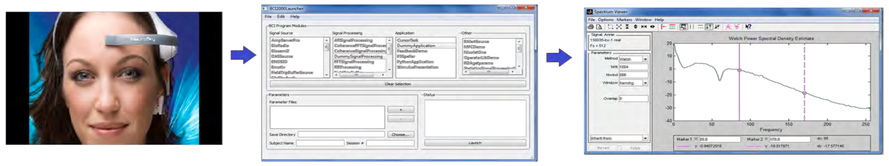
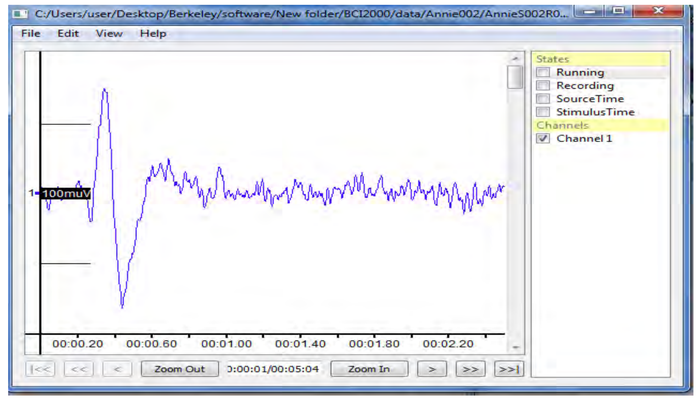
## Project Focus: Detection of Fatigue

- Modern encephalographic (EEG) devices are:
  - portable; flexible; inexpensive
- We investigate the potential to employ EEG devices for operators of safety-critical equipment:
  - detect inadequate brain states; increase operator awareness; improve safety; reduce the number of disasters caused by human error, esp. fatigue



EEG signal acquisition | Data recording in BCI2000 | Data analysis in Matlab

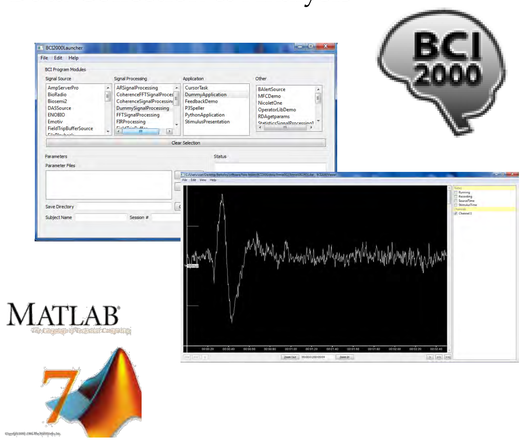
**Experimental Framework**




**Sample RAW EEG data**

## Equipment & Methodology

- Comparison of three EEG devices
- Data Collection & Analysis



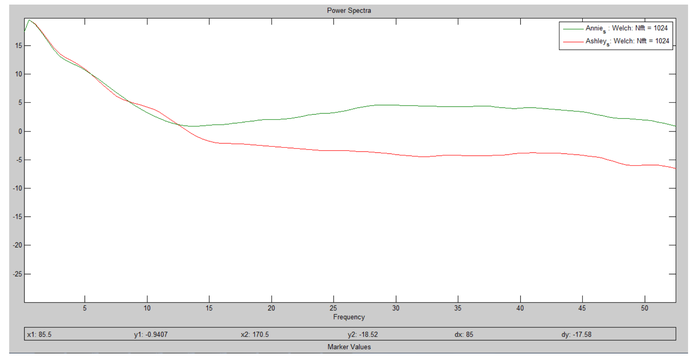
**Sample RAW EEG data observed in BCI2000 Launcher software, (b) Matlab Sginal Processing Tool Kit used for data analysis**

(I) (II) (III)

**Wearable EEG Devices: (I) MindWave, (II) MindSet, (III) MyndPlay Mindband**

| | I | II | III |
|---|---|---|---|
| EEG Channels | 1 | 1 | 1 |
| Connectivity | Wireless RF Adapter | Bluetooth | Bluetooth |
| Wireless Output | RF | Bluetooth (audio and voice) | Bluetooth |
| Receiver | USB RF Receiver | Bluetooth | Bluetooth |
| Reference (ground) type | Ear clip | Earphone pad | Ear Hook |
| Appearance | Headset | Headset with headphones | Velcro headband |
| Cost | $99 | $199 | $150 |

**Comparative Table of Neurosky Devices**




**Sample spectral analysis, comparison of fatigued (red) and alert (green) states of the subject**

Data collection and analysis for (I)

## Comparative Analysis of the Devices

- A signal could not be acquired from device (III)
- Device (II) produces significantly "noisy" data
  - Engineering of headset prevented stable ground from being acquired
- Device (I) produces the best (the least noisy) data
  - Ear clip provides secure and dependable reference
  - Easily connects to BCI2000 and Matlab software applications

## Devices Conclusions

- Device (I) considerably outperforms devices (II) and (III)
- From our analysis, most important for detection of drowsiness are:
  - Alpha and beta waves with frequencies 10 -- 25 Hz
- Further research agenda: Perform extensive experimentation aiming to:
  - Determine the indicators of subject's state: ex. eyes open vs. closed
  - Identify minimal time interval(s) for reliable detection of fatigue

This work was supported by the TRUST Center (NSF award number CCF-0424422)