Multifocal VEP Signal Dependence on Stimulus Area

Justin Ales, Thom Carney, Thang Duong, Stanley A. Klein

Vision Science Program
University of California, Berkeley
Introduction

• Our goal is to create a high resolution spatial and temporal map of early visual areas using EEG/MEG
• Large stimuli degrade localization ability
• Many small stimuli are better
• Signal Strength decreases with small stimuli

Figure From:
Structure of the Human Brain,
S. DeArmond, M. Fusco, M. Dewey
Stimulus Timing

Traditional EP signal
Stimulus Configuration

- 48 Patches
- 4 Rings, 12 Spokes
- 5 patch widths
  - 7
  - 6
  - 4
  - 2
  - 1
Experimental Design

- Each size condition was presented for 65536 (2^16) video frames at 60 Hz for a total of 19 minutes per session
- Each day we presented all 5 sizes for a total of 95 minutes of recording
- This was repeated over 4 days for a total 76 minutes of data for each size
- The 4 days were averaged
Cortical Sizes

- $\text{d}X = A \times \text{d}\Theta / (E + E^2)$
- $A \sim 20$ (Horton & Hoyt, 19??)
- $\text{d}\Theta = 7.5$ degrees
- $\text{d}X = 2$ mm per width of 1 square
- Area of size 1 = $16$ mm$^2$
- Area of size 7 = $112$ mm$^2$
Cortical Size

• Coronal Section
  human brain, right hemisphere, occipital lobe

• Green lines indicate extent of striate cortex

Figure From:
Structure of the Human Brain,
S. DeArmond, M. Fusco, M. Dewey
Cortical Size

- Coronal Section
  human brain, right hemisphere, occipital lobe
- Green lines indicate extent of striate cortex
- White line highlights striate cortex

Figure From:
Structure of the Human Brain,
S. DeArmond, M. Fusco, M. Dewey
Cortical Size

- Coronal Section
  - human brain, right hemisphere, occipital lobe
- Green lines indicate extent of striate cortex
- White line highlights striate cortex
- Size 1, 2 mm

Figure From:
Structure of the Human Brain,
S. DeArmond, M. Fusco, M. Dewey
Cortical Size

- Coronal Section
  human brain, right hemisphere, occipital lobe
- Green lines indicate extent of striate cortex
- White line highlights striate cortex
- Size 4

Figure From:
Structure of the Human Brain, S. DeArmond, M. Fusco, M. Dewey
Cortical Size

- Coronal Section
  human brain, right hemisphere, occipital lobe
- Green lines indicate extent of striate cortex
- White line highlights striate cortex
- Size 7

Figure From:
Structure of the Human Brain,
S. DeArmond, M. Fusco, M. Dewey
Signal to Noise Calculations

Voltage as a function of Time
Signal to Noise Calculations

Voltage as a function of Time

RMS Signal Region
Signal to Noise Calculations

Voltage as a function of Time

- RMS Signal Region
- RMS Noise Region
Conclusion

- Linear grand average
- The smallest size deviates from linearity indicating a threshold
- Individual patch deviations from linearity could be explained by cortical folding
- It is possible to record signals from very small patches
- Small active areas increase the ability to localize sources of electrical activity