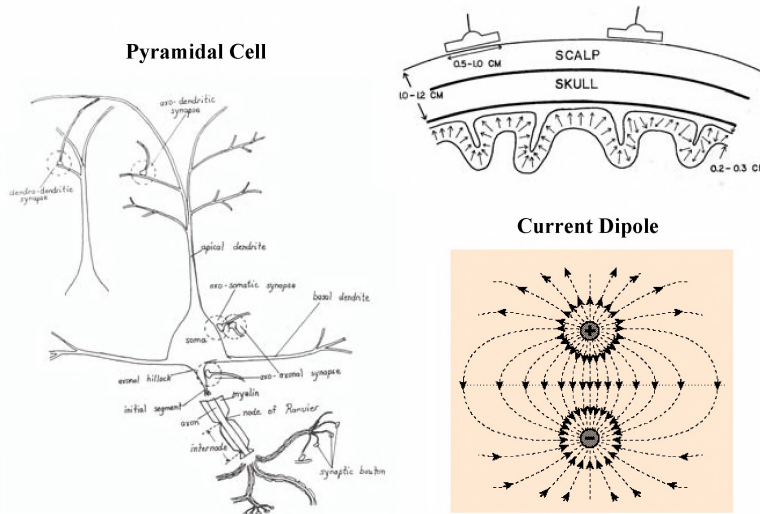


Presentation 8 – Thomas Ferree

EEG Program for Gulf War Research

Thomas Ferree, PhD
*Department of Radiology
UT Southwestern Medical Center*

Cellular Sources of EEG



Cortical Sources of EEG

Cortical Sheet



Axonal Fibers



Added Value of EEG for Gulf War Research

General

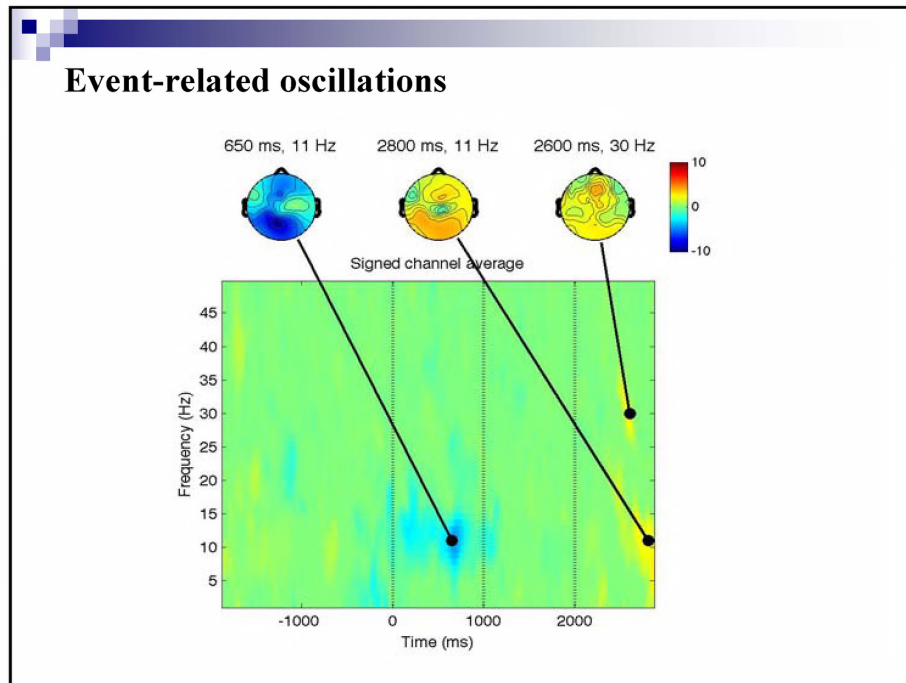
- Measure neural activity with millisecond timing
- Detect oscillations within and between brain areas
- Impairment within areas or communication between areas?

Word-Word Binding

- Associate oscillations with cognitive processes
- Distinguish processes through their temporal ordering

Continuous Performance

- Ability to analyze continuously through time
- Power spectrum correlates with performance

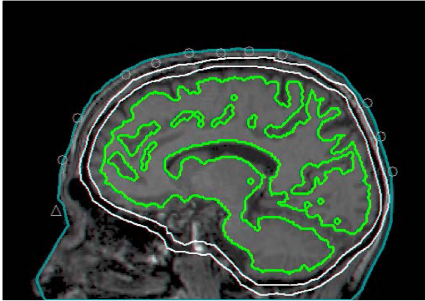


EEG Analysis Domains and Clinical Indices

- Time Series Analysis**
 - Event-related transients (peak amplitude, latency)
 - Event-related oscillations (amplitude, timing)
- Spatial Analysis**
 - Electric head modeling
 - Source localization (functional networks)
- Integration with functional MRI**
 - Spatial co-registration
 - Simultaneous recording
- Functional connectivity**
 - Coherence (magnitude, phase, connectivity maps)
 - Relationship to fMRI and DWI

Electric Head Modeling: Two Components

1. Geometry



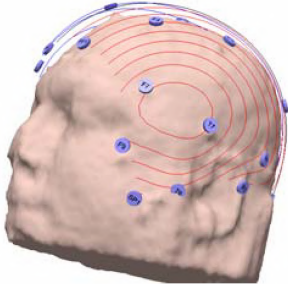
2. Conductivity

Tissue	Mean σ	Stdev σ
Brain	0.25	0.13
CSF	1.79	0.02
Skull	0.018	0.014
Scalp	0.44	0.2

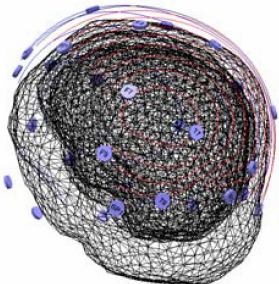
Can measure conductivity non-invasively with EIT:
(Electric Impedance Tomography)

Electric Source Localization

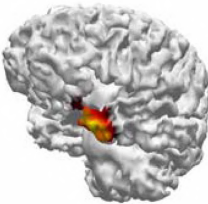
Scalp Voltage Data



Electric Head Model



Brain Source Current



Simultaneous EEG and Functional MRI

Motivations

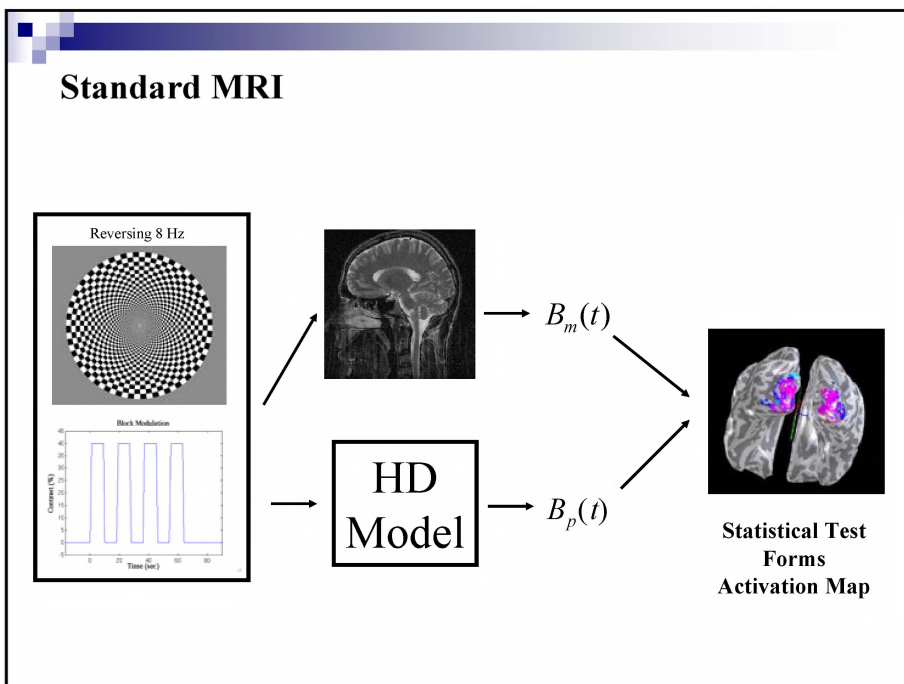
- Best of both worlds: spatial and temporal resolution
- Match recording environment and stimulation parameters
- Match subject state, e.g., alertness, etc.
- Avoid training effects
- Convenience

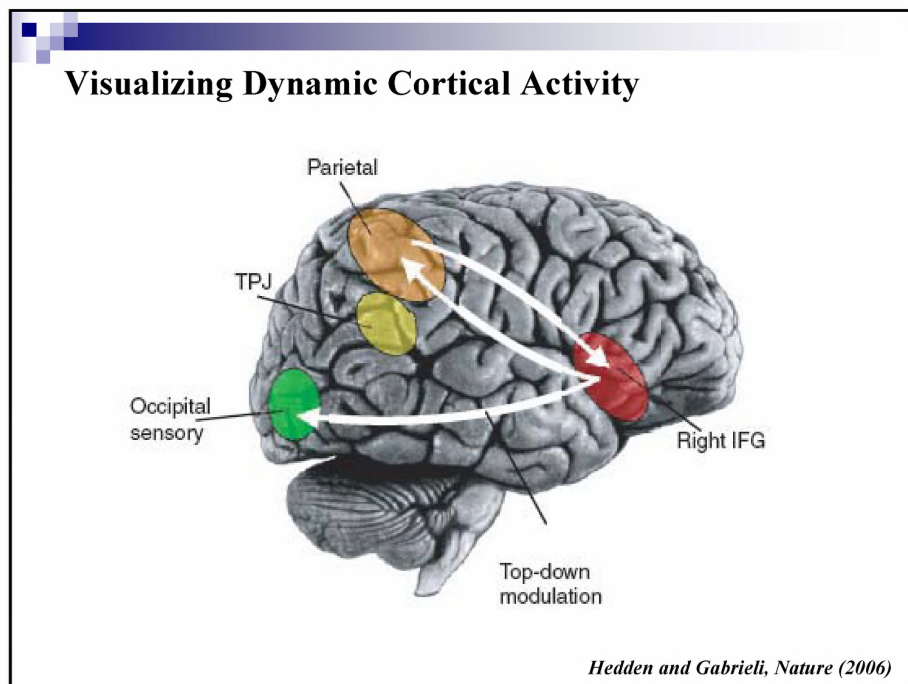
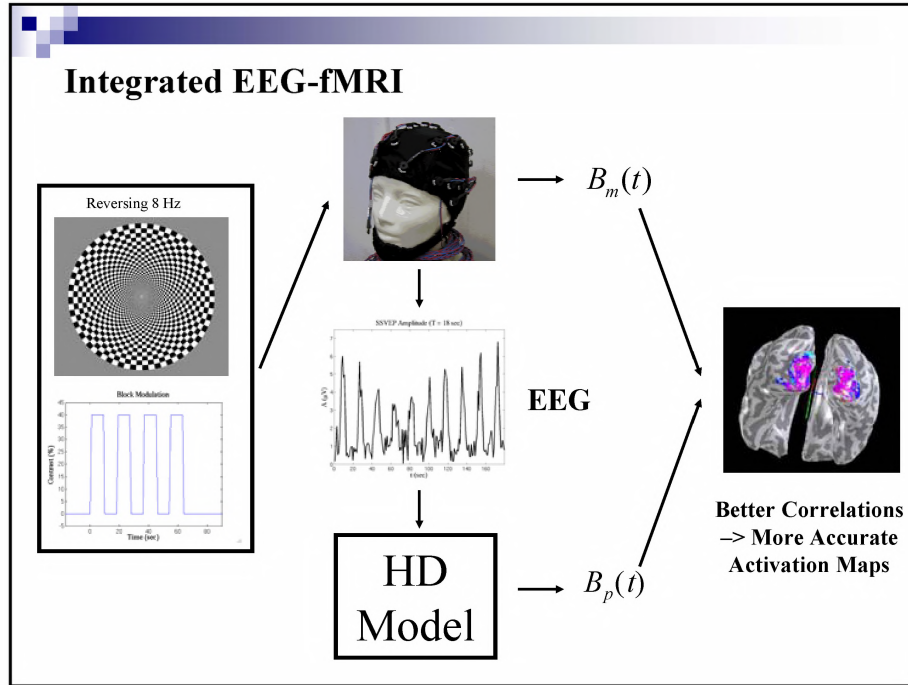
Challenges

- Artifacts induced by MR magnetic fields
- Optimize cognitive paradigms for EEG and fMRI

Larger Goals

- Clarify relationship between neural oscillations and fMRI maps
- Improved statistical tests for functional activation





EEG Program Development

Done

- IRB approval for EEG, EEG-fMRI
- Protocols for cap application, cleaning, etc.
- System integrity
- Data quality and artifact reduction
- EEG pilot studies in normal subjects
- Preliminary analyses of EEG data

To Do

- Integrate EEG/EIT into full pilot studies
- Extend IRB approval to EIT
- Space renovations, booth installation
- Equipment upgrades, purchases
- New hires, training

Main Collaborators

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Aman Goyal
Kaundinya Gopinath
Mette Posamentier
Pat Carmack
Jeff Spence

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Mandy Maguire
Gail Tillman
Cliff Calley
Matt Brier
Tim Green

SMU

Wayne Woodward
Henry Gray

...More To Come