

BCI 2002 Workshop



Multimodal Neuroelectric Interface Development

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Overview

What's New About this Research

- Interfaces for mobile or restricted environments
- Augmented interaction in normal environments

Research Interests

- EMG- and EEG-based control
- Multimodal control
- Real-time algorithms
- Signal processing framework
- Contactless sensors



Aircraft Simulation

Demonstration: Eight channels of EMG are recognized as flight stick motions

F-15 Simulation
757 Transport Simulation



Typing Demonstration

Demonstration: Eight channels of EMG are recognized as keystrokes when pretending to type on a keyboard number pad.

Purpose

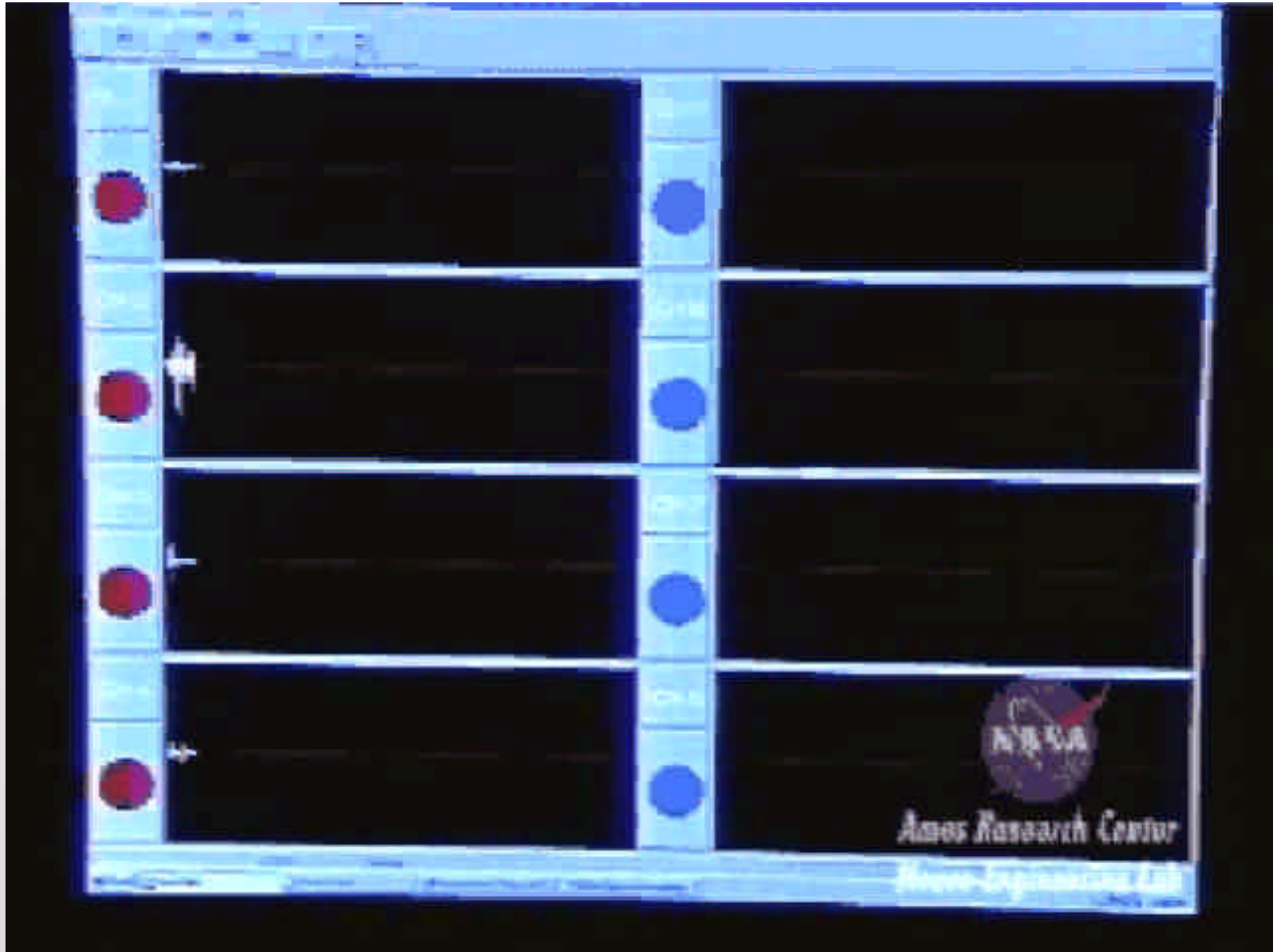
- Replace physical keyboard
- Keep hands free of gloves or other apparatus

Issues

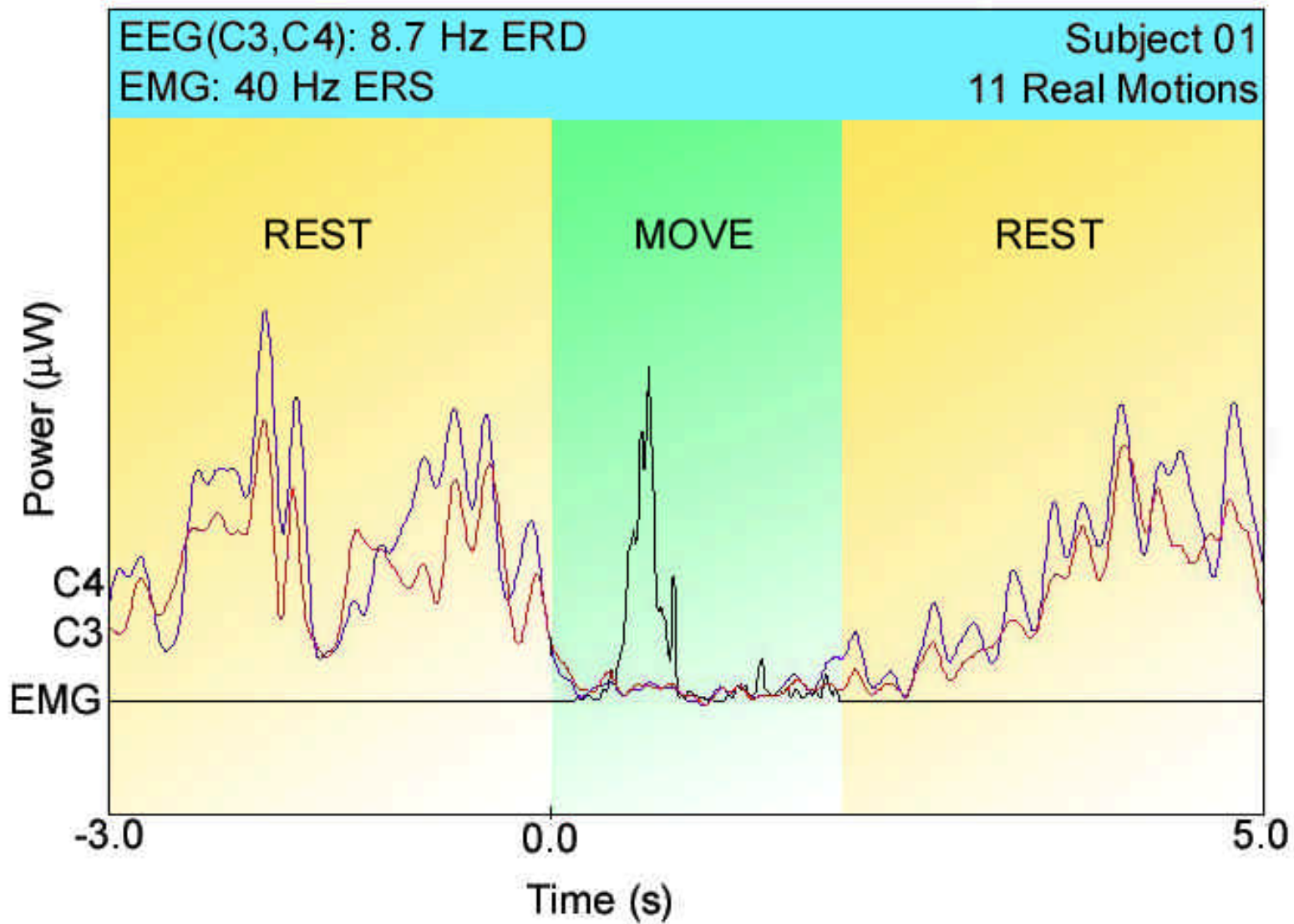
- Typing style is critical
- Adjust sensors and algorithms to individual
- Unobtrusive sensors



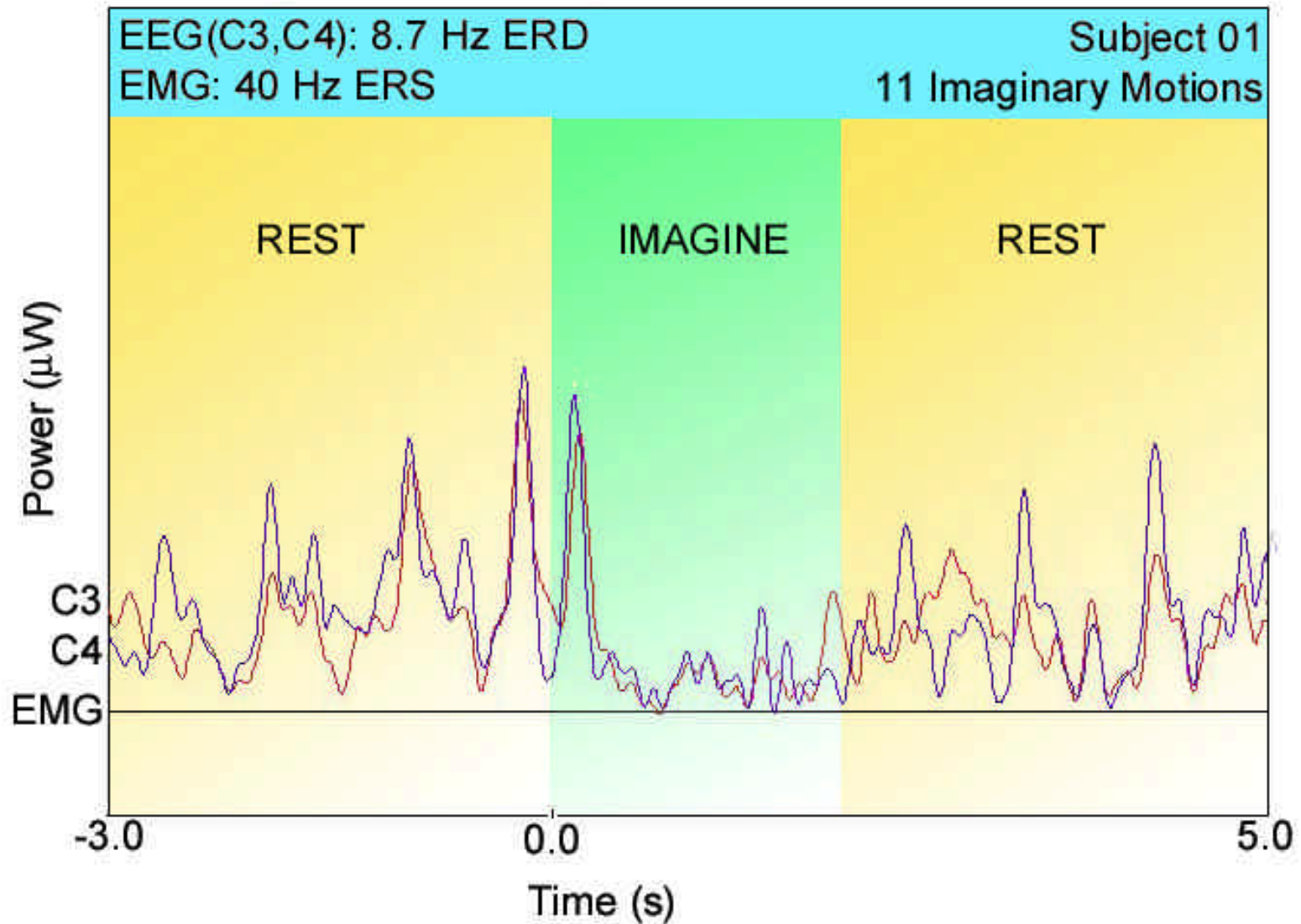
EMG Control Demo



Reaching Task - Eleven Motion Epochs
8.7 Hz ERD at C3 & C4 from -3 to +5 sec relative to onset of motion



Imaginary Reaching Task - Eleven Motion Epochs
8.7 Hz ERD at C3 & C4 from -3 to +5 sec relative to onset of motion



Closed-loop 1-D Control Experiments

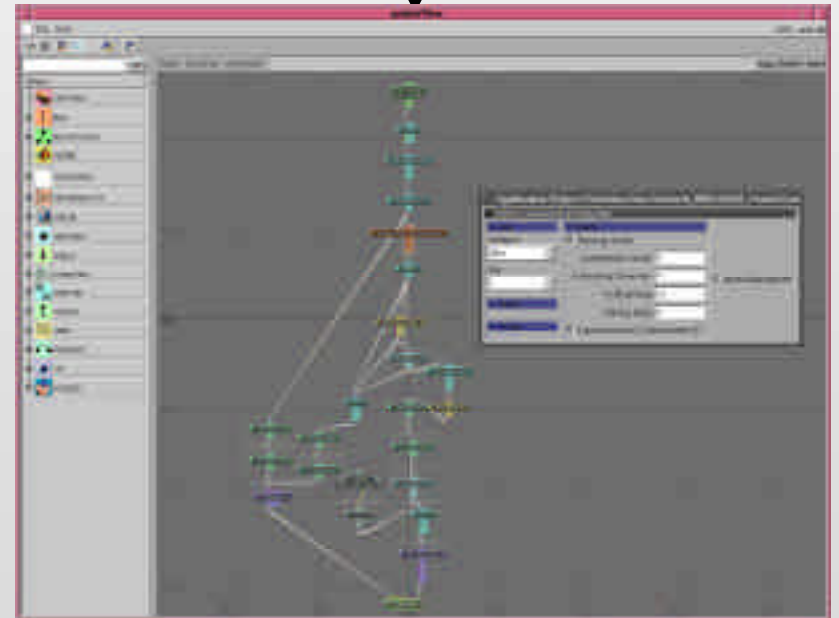
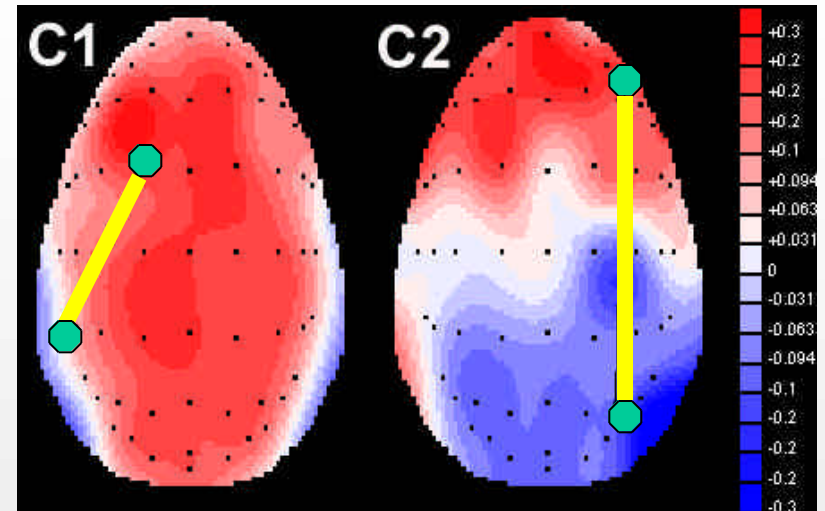
HIGH density EEG signal from motion tasks

Spatial separation of oscillatory sources

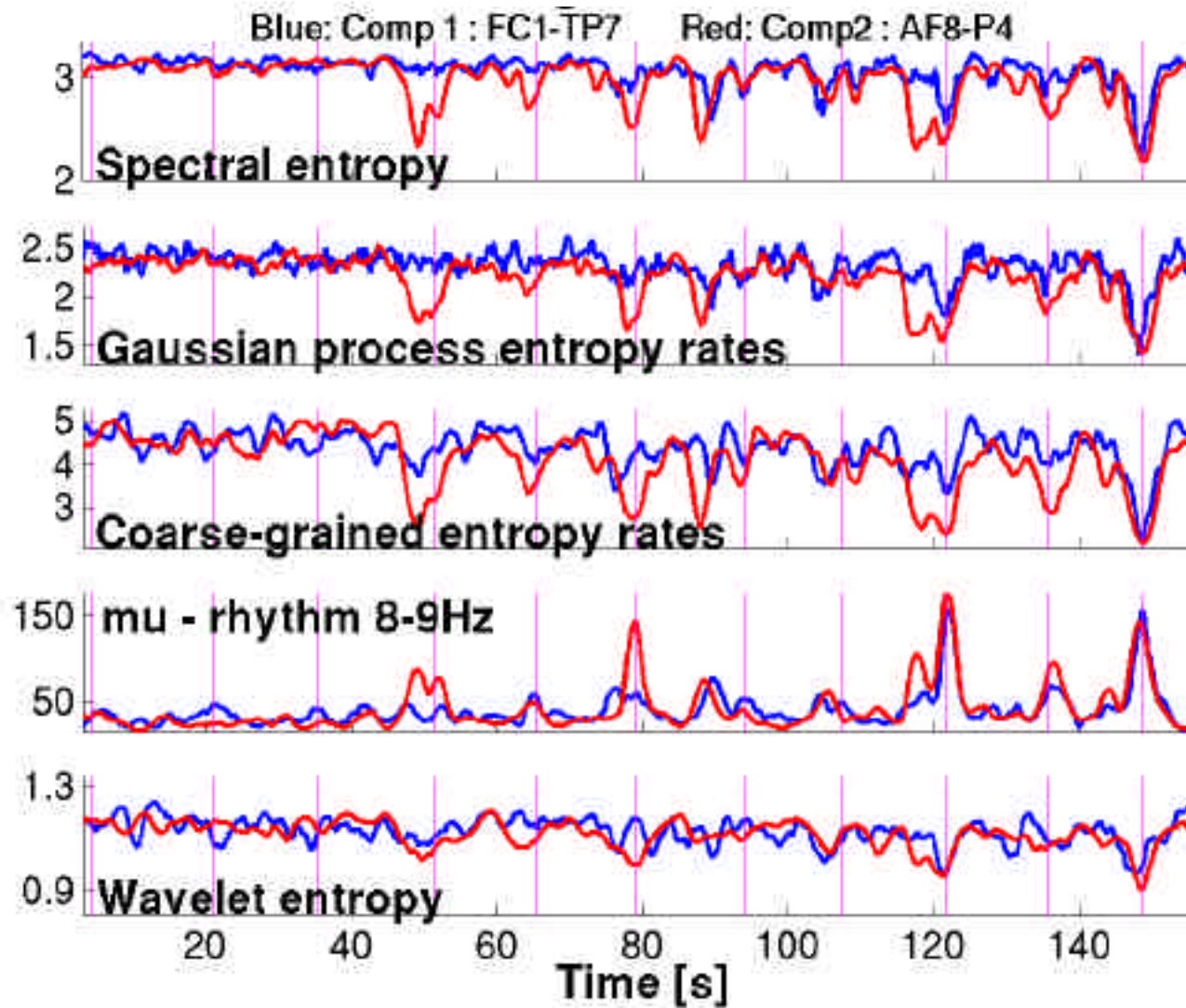
Approximate sources with best electrode pairs

Real-time system:

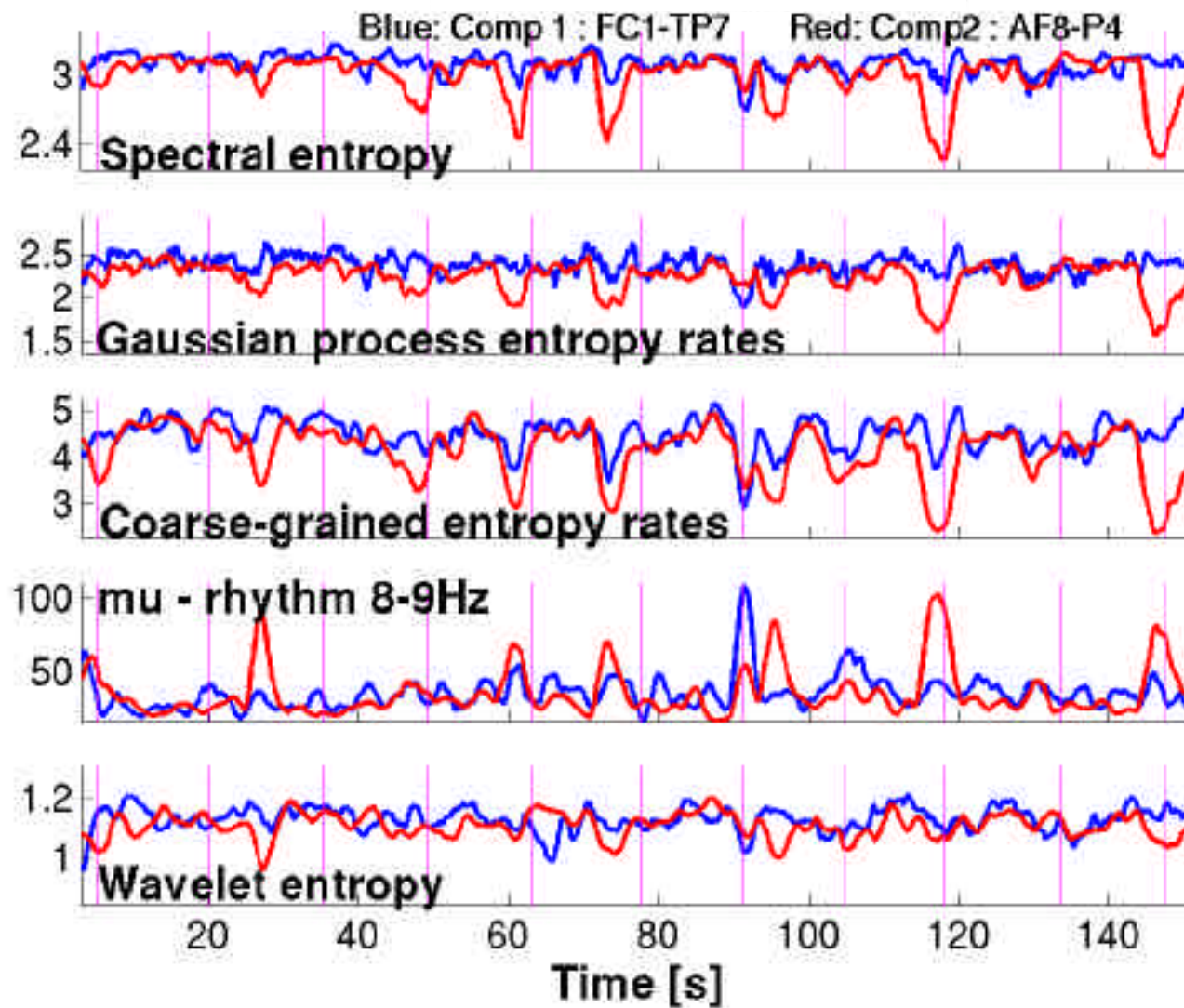
- spectral or non-spectral features
- adaptive scale and location estimates



Real Right-hand Motion



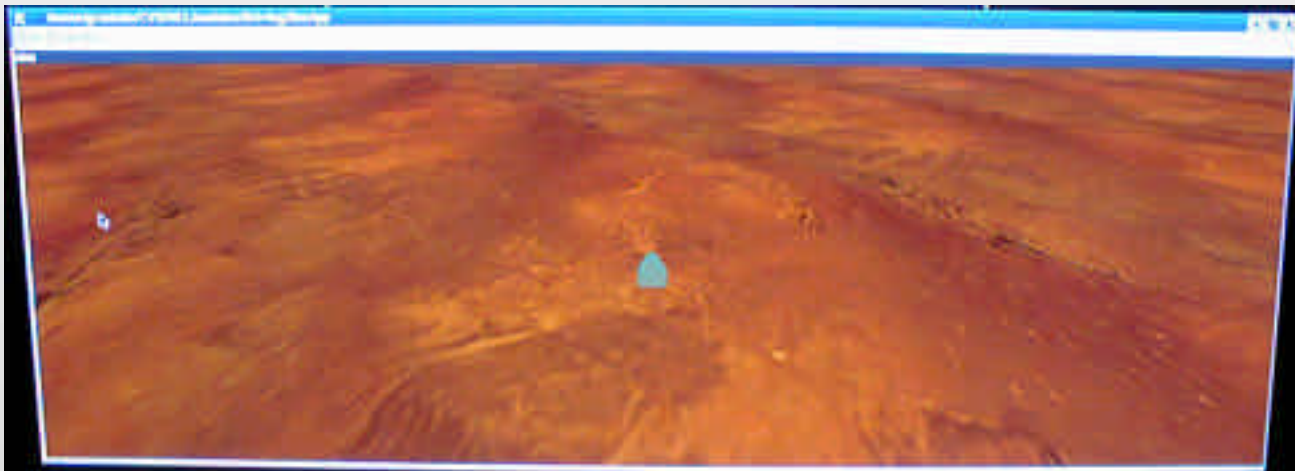
Imaginary Left-hand Motion



Closed Loop Training Task

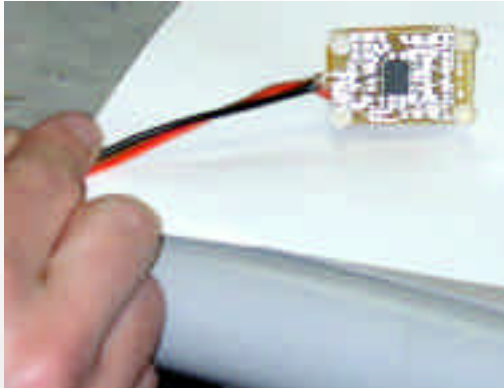


Closed Loop Moving Map Control

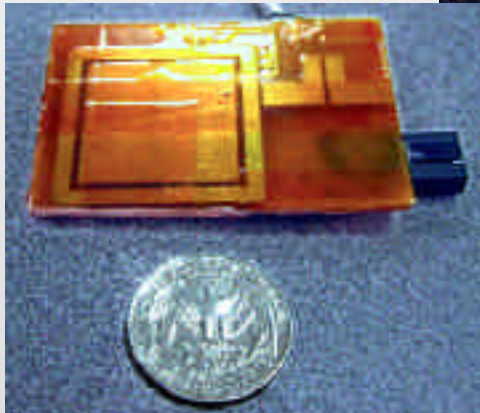


Non-contact Sensor Development

QUASAR Stacked Sensor



Eight-channel EEG plus EOG
and QUASAR Sensor Recordings



Lash-up of Mini-differential
Quasar Sensor

QUASAR: Quantum Applied Science and Research Inc.

Design Goals

Near-term

- Refine non-contact technology
- E-field sensor (normal to scalp)
- Shielded room

Mid-term

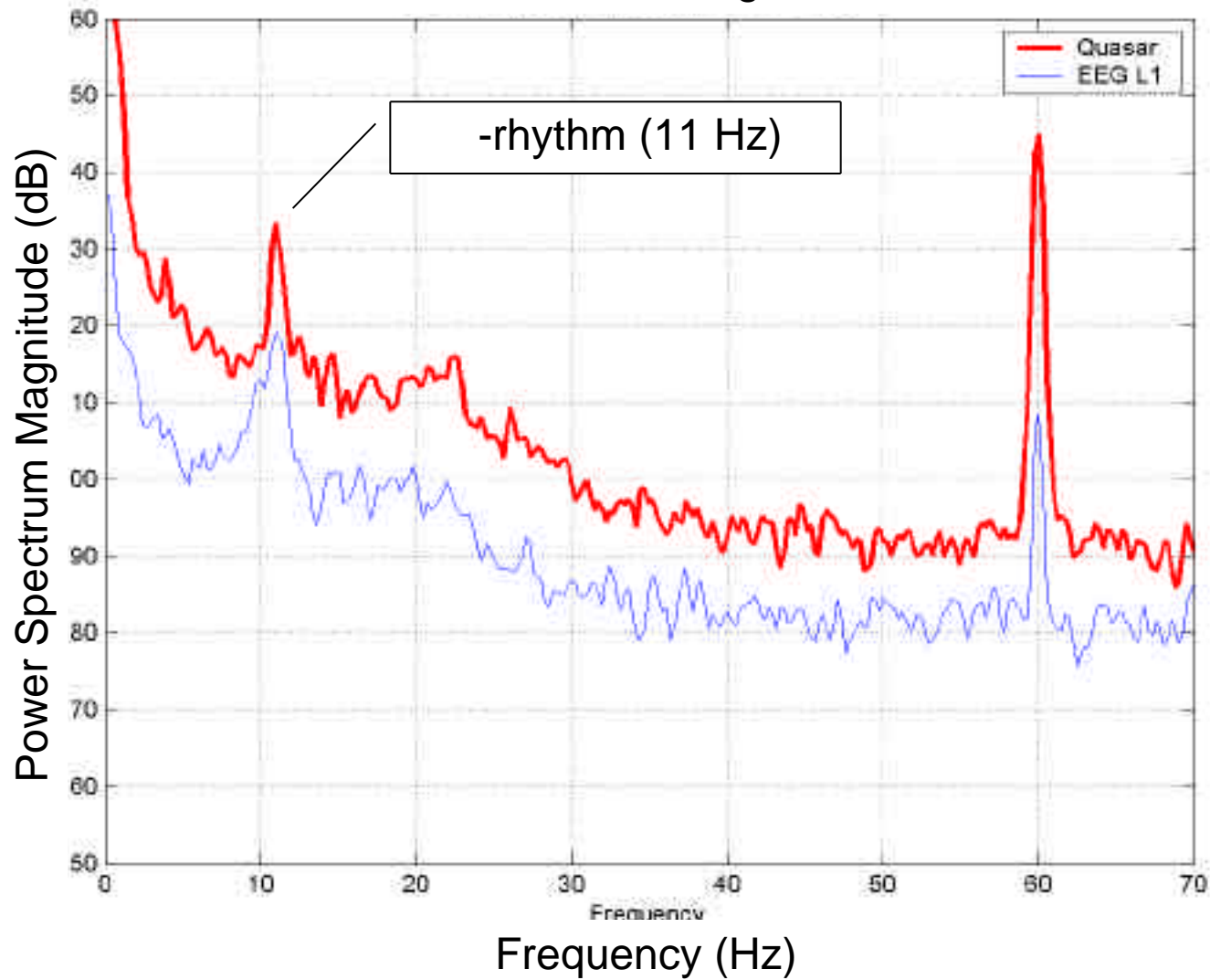
- Differential sensor (tangential to scalp)
- Mini sensors (2-3X smaller, thinner, with manufactured cover)

Long-term

- Unshielded room
- Multichannel

Capacitive Sensor Data

Visual Monitoring Task



Future Directions

- Multimodal neuroelectric control with concurrent motion
- Communication and control using event-related cortical potentials (attention, intention)
- Wireless/contactless technology for neuroelectric control
- Validate contactless sensors with ECoG or intracranial recordings