Summer in Dr. Ojemann’s Lab

Anthony Wohns and Dennis Wang

Electrocorticography

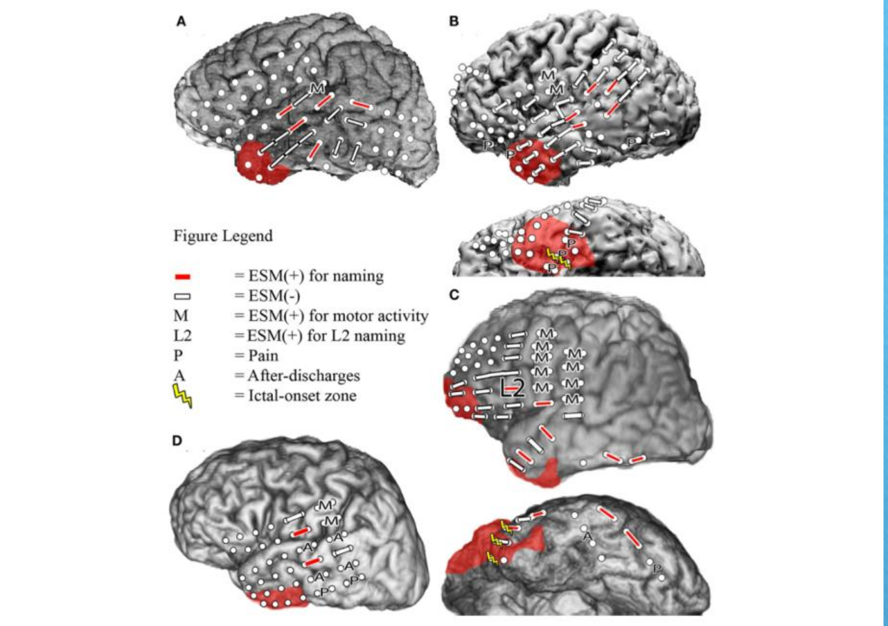
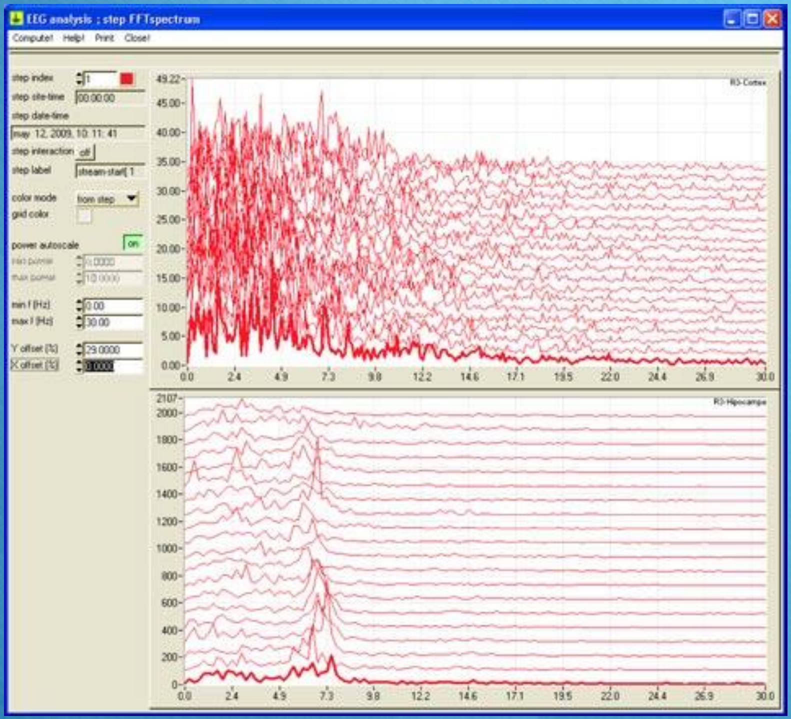
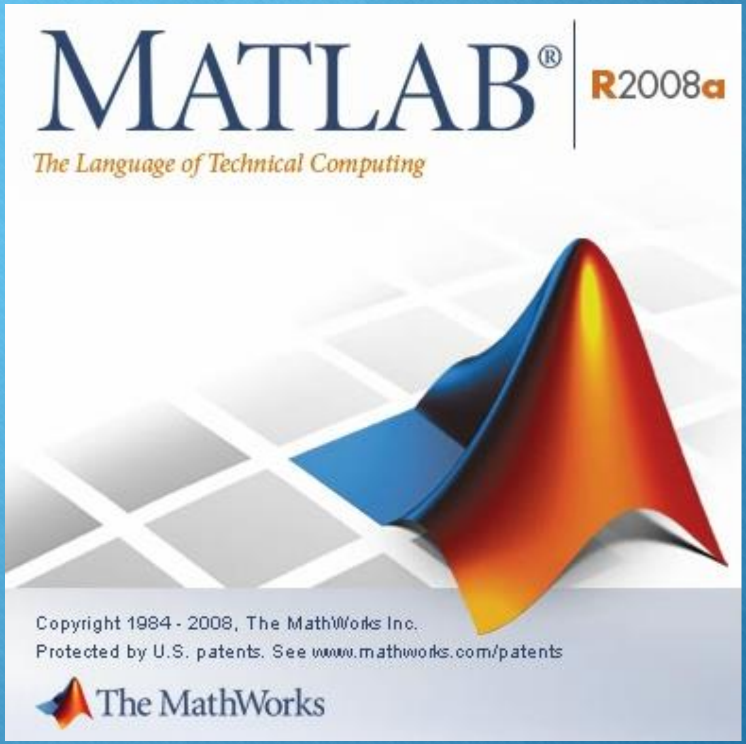


FIGURE 1 | Bipolar electrocortical stimulation mapping of visual object naming of L1 and L2 in Patient 1 (A), Patient 2 (B), and Patient 3b (C), and only in L2 in Patient 4 (D) using co-registration of a post-surgical CT with pre-surgical MRI to determine electrode placement. Left lateral and left basal views are shown when applicable. White circles indicate the locations of the implanted subdural electrodes. In Patients 1 and 4, the ictal-onset zone was in the left mesial temporal region and is not depicted. Areas with red shading indicate the resection boundaries. No basal temporal ESM was performed in these patients, so basal views are not included.

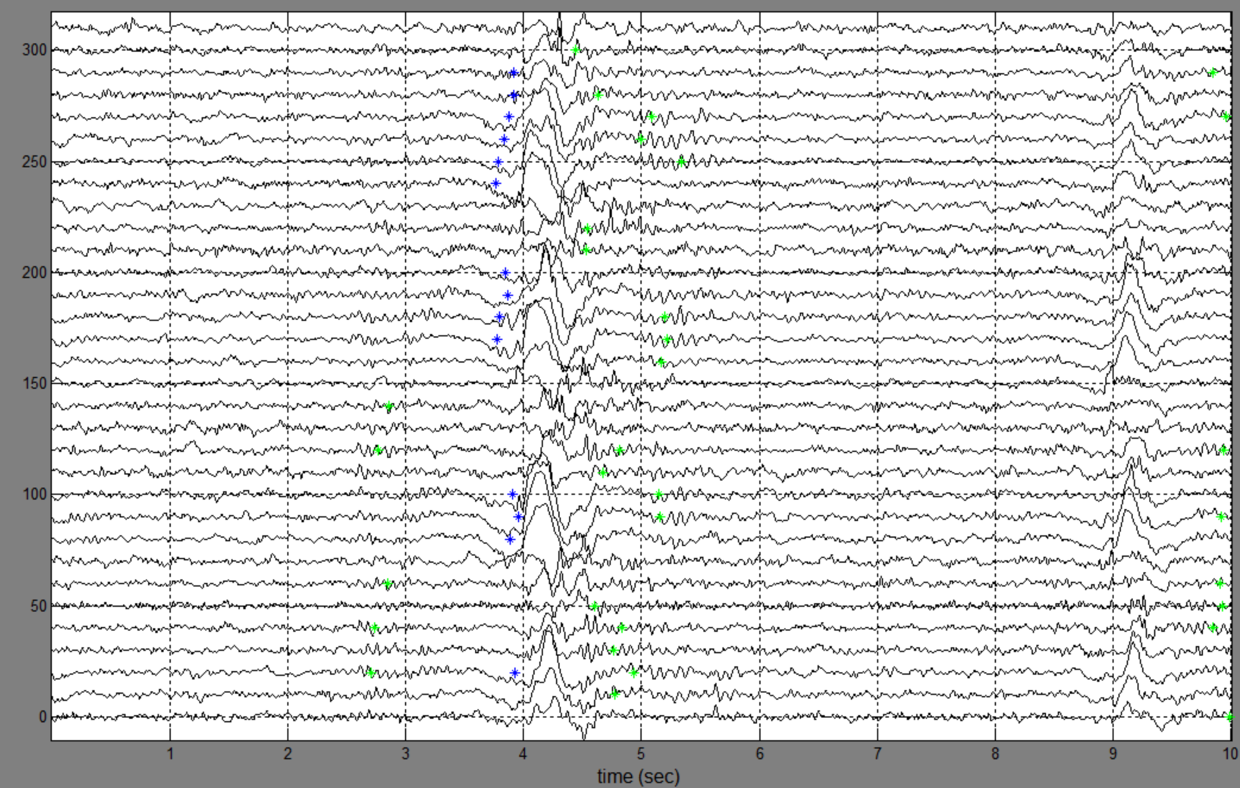
MATLAB & Sleep Scoring



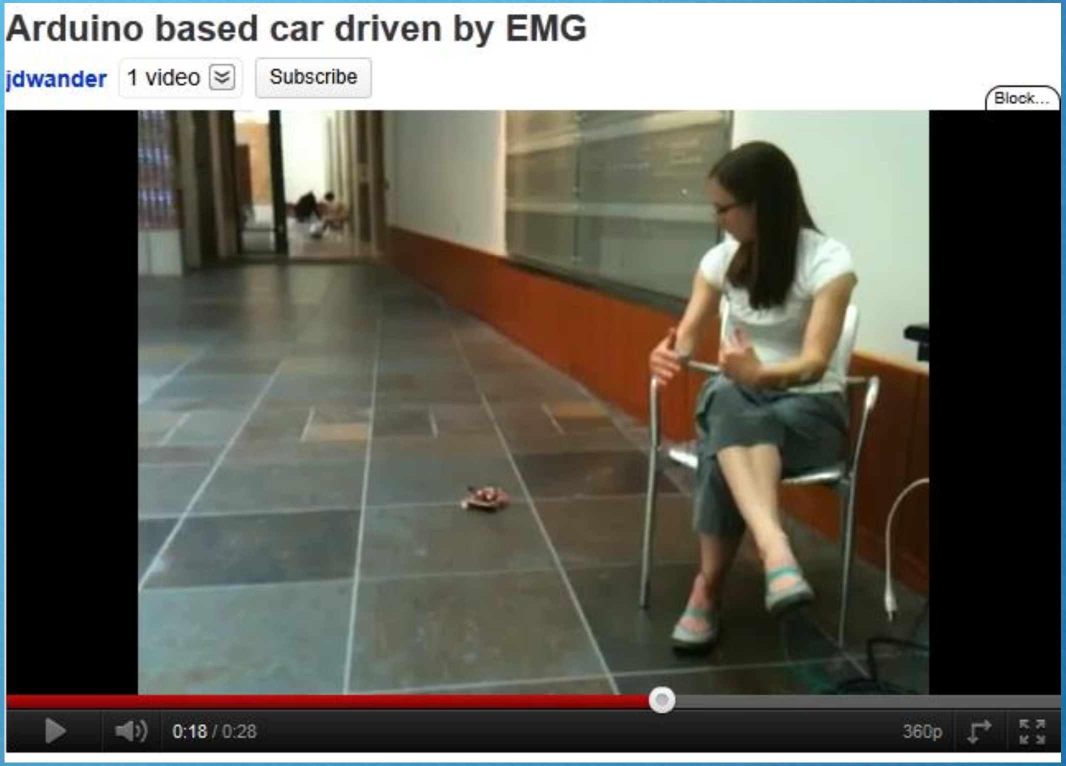


MATLAB & Sleep Scoring

- K complexes and sleep spindles



UW Math Academy



Website

- http://www.weebly.com/weebly/userHome.php

Poster

- Different types of Brain Computer Interfaces (BCI)
  - Invasive
  - Partially Invasive
  - Noninvasive

Reviewed Papers

frontiers in
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Long-term asynchronous decoding of arm motion using electrocorticographic signals in monkeys

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Brain–machine interfaces (BMIs) employ the electrical activity generated by cortical neurons directly for controlling external devices and have been conceived as a means for restoring human cognitive or sensory-motor functions. The dominant approach in BMI research has been to decode motor variables based on single-unit activity (SUA). Unfortunately, this approach suffers from poor long-term stability and daily recalibration is normally required to maintain reliable performance. A possible alternative is BMIs based on electrocorticograms (ECoGs), which measure population activity and may provide more durable and stable recording. However, the level of long-term stability that ECoG-based decoding can offer remains unclear. Here we propose a novel ECoG-based decoding paradigm and show that we have successfully decoded hand positions and arm joint angles during an asynchronous food-reaching task in monkeys when explicit cues prompting the onset of movement were not required. Performance using our ECoG-based decoder was comparable to existing SUA-based systems while evincing far superior stability and durability. In addition, the same decoder could be used for months without any drift in accuracy or recalibration. These results were achieved by incorporating the spatio-spectro-temporal integration of activity across multiple cortical areas to compensate for the lower fidelity of ECoG signals. These results show the feasibility of high-performance, chronic and versatile ECoG-based neuroprosthetic devices for real-life applications. This new method provides a stable platform for investigating cortical correlates for understanding motor control, sensory perception, and high-level cognitive processes.

Keywords: decoding, electrocorticography, ECoG, arm, asynchronous, long-term, brain-machine interface, BMI

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Language mapping in multilingual patients: electrocorticography and cortical stimulation during naming

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Multilingual patients pose a unique challenge when planning epilepsy surgery near language cortex because the cortical representations of each language may be distinct. These distinctions may not be evident with routine electrocortical stimulation mapping (ESM). Electrocorticography (ECoG) has recently been used to detect task-related spectral perturbations associated with functional brain activation. We hypothesized that using broadband high gamma augmentation (HGA, 60–150 Hz) as an index of cortical activation, ECoG would complement ESM in discriminating the cortical representations of first (L1) and second (L2) languages. We studied four adult patients for whom English was a second language, in whom subdural electrodes (a total of 358) were implanted to guide epilepsy surgery. Patients underwent ECoG recordings and ESM while performing the same visual object naming task in L1 and L2. In three of four patients, ECoG found sites activated during naming in one language but not the other. These language-specific sites were not identified using ESM. In addition, ECoG HGA was observed at more sites during L2 versus L1 naming in two patients, suggesting that L2 processing required additional cortical resources compared to L1 processing in these individuals. Post-operative language deficits were identified in three patients (one in L2 only). These deficits were predicted by ECoG spectral mapping but not by ESM. These results suggest that pre-surgical mapping should include evaluation of all utilized languages to avoid post-operative functional deficits. Finally, this study suggests that ECoG spectral mapping may potentially complement the results of ESM of language.

Keywords: multilingual, naming, electrocorticography, ECoG, high gamma, functional mapping, electrocortical stimulation mapping, epilepsy surgery

Lab Cart

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