Neuroscience 2015

Presentation Abstract

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Program#/Poster#:	815.16/Z18
Presentation Title:	The large-scale spatiotemporal structure of spindle oscillations in human sleep
Location:	Hall A
Presentation time:	Wednesday, Oct 21, 2015, 1:00 PM - 5:00 PM
Presenter at Poster:	Wed, Oct. 21, 2015, 4:00 PM - 5:00 PM
Topic:	++E.08.e Sleep: Systems
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Abstract:	During stage II sleep, neocortical circuits exhibit transient epochs of narrowband oscillations in the 11-15 Hz frequency band. The physiological substrate for these "spindle" oscillations is the interplay of activity within the

	thalamus, providing transient synchronization across the neocortex through thalamocortical feedback loops. Although there is increasing evidence that spindles are involved in the consolidation of long-term memories, the specific neural mechanisms by which this occurs remain unclear. Evidence from electroencephalography suggests large-scale coherence across the cortex during spindles, but their specific spatiotemporal structure during natural sleep is not well understood. In this work, we study electrocorticogram (ECoG) recordings of patients during stage II sleep and apply phase-based methods to characterize the spatiotemporal dynamics. During spindling activity, the ECoG array exhibits a specific, robust spatiotemporal pattern: large-scale rotating waves traveling from parietal to temporal to frontal to parietal cortex. These recurring spatiotemporal patterns are observed in the left and right hemisphere of individual patients and extend over tens of milliseconds, placing the neural assemblies they synchronize on a timescale relevant to spike-time dependent synaptic plasticity. Finally, we introduce a method to detect phase-based motifs in narrowband signals, in order to study precise fluctuations of activity within these recurring spatiotemporal patterns. We find indeed that precise phase relationships during spindles on the electrode array recur across several minutes of sleep, further demonstrating the precision and importance of relative timing among electrodes during sleep oscillations in humans. -- Acknowledgments: The authors would like to thank the clinical subjects for their participation in the research. All research was approved by the local institutional review board, and electrode placement was determined solely by clinical criteria. This work was supported by NIH (R01 NS-036449 and 5 T32 EY 20503-5), ONR (MURI award N000141310672), and Howard Hughes Medical Institute.
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	SLEEP SPINDLES

	SPATIOTEMPORAL DYNAMICS
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