Dissecting long-range circuits in macaque cortex by registering optogenetically driven neural activity with anatomical connectivity

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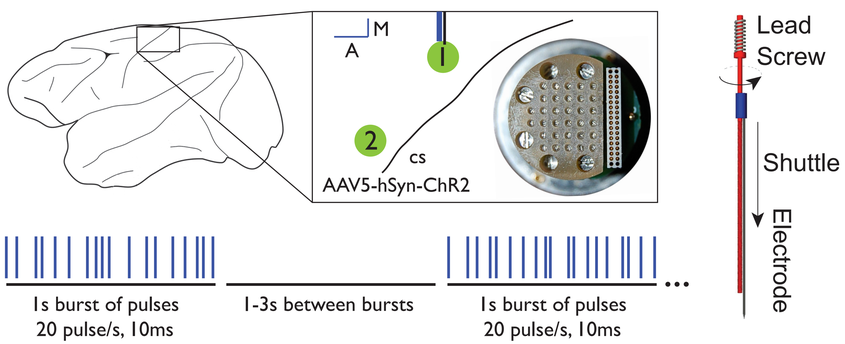
Introduction:

Previous work in the lab suggests that neurons that have correlated activity with other brain areas have enhanced representations of behavioral plans.

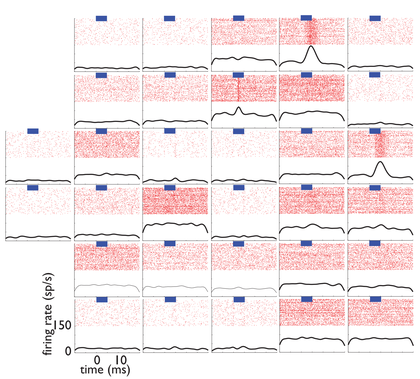
We used optogenetic techniques to causally test the role of connectivy in relaying nerual signals across long-range circuits by measuring how coherence affects the non-local response to driven input.

We also compared physiological connectivity with anatomical connectivity by performing a reconstruction of the tissue and measuring the amount of GFP labelling at recording sites.

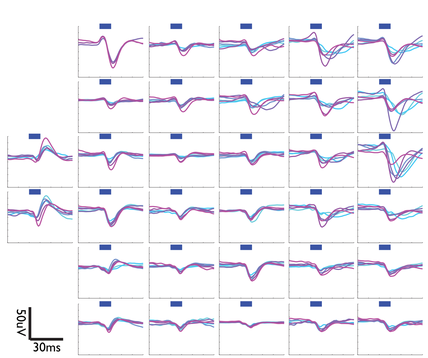
Resonses to optogenetic stimulation in motor cortex recorded in parietal cortex in an anesthetized macaque



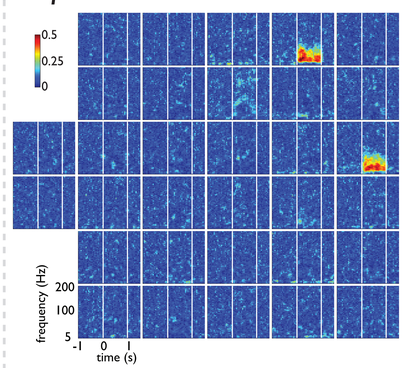
Multiunit response to pulse



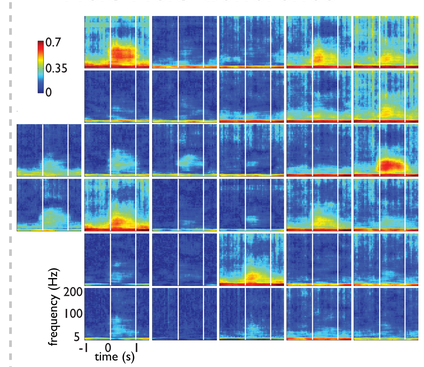
Evoked LFP across depths



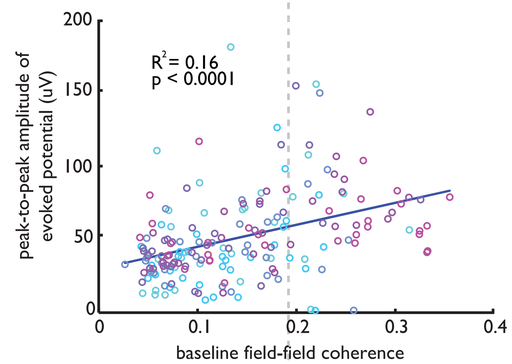
Spike-Field Coherence



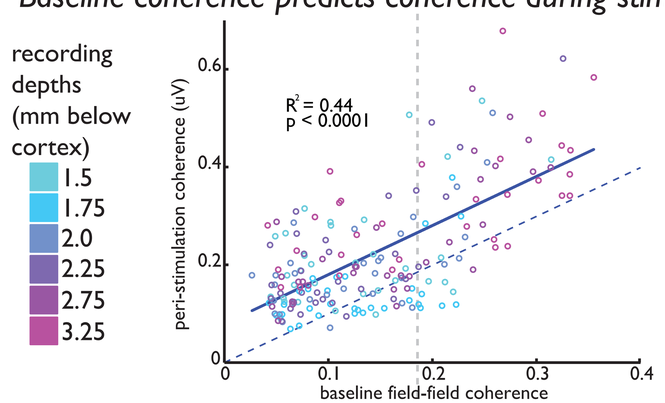
Field-Field Coherence



Sites with higher baseline coherence have larger evoked potentials



Baseline coherence predicts coherence during stimulation

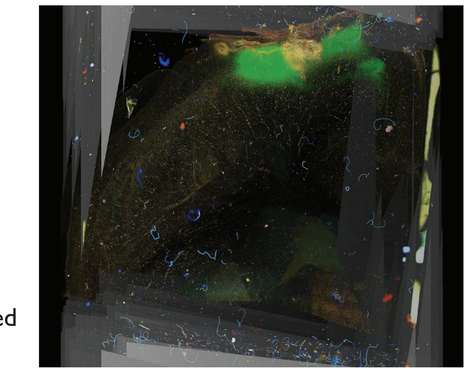


Injection and recording sites were reconstructed for performing quantitative histology

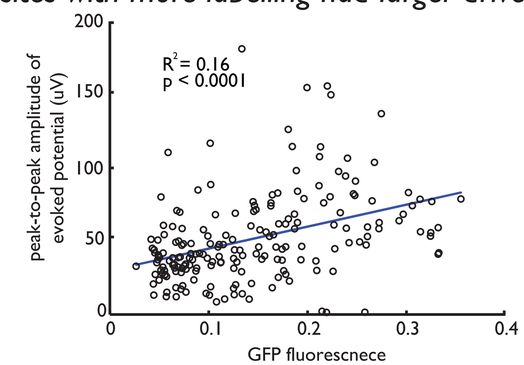
Tissue sections were acquired at 20um thickness and imaged for GFP fluorescence.

Digital images were transformed (rotation and translation) using an algorithm to find optimal alignment.

3D reconstruction was performed on aligned images in ImageJ.



Recording sites with more labelling had larger driven responses



Conclusions:

Optogenetic stimulation is able to drive evoked potentials and spiking activity outside of the stimulated area.

Long-range circuits that have higher baseline coherence and greater anatomical connections with the stimulated region are more likely to have a greater response to stimulation.

Coherence may be useful for dissecting the circuits which route information.

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