Distinct neuronal contributions to high frequency power changes in human local field potential recordings

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1. Introduction

The neuronal mechanisms that drive spectral changes in the local field potential (LFP) are poorly understood[1]

Asynchronous high frequency power (HFP, 50-200 Hz) is postively correlated with neuronal spiking (FR)[2,3]

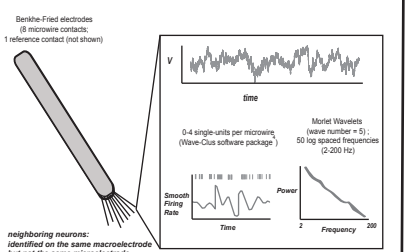
Here, we assess whether there are non-linearities in the FR--HFP relation in the human intracranial recordings

2. Methods

Single neurons (n = 2,030) and LFPs simultaneously recorded from 20 neurosurgical patients as they performed spatial navigation tasks

Identified 330 HFP+ neurons ($p < 0.05$, shuffle procedure)

Subdivided neurons into superlinear, linear and sublinear based on quadratic regression fit to FR-HFP relation ($p < 0.05$, shuffle procedure)



*Only considered neurons with > 1 Hz baseline firing rate and >14 min of data

Measures of neural activity:

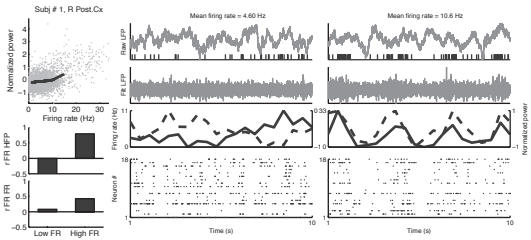
FR: Smooth firing rate measured over 500 ms epochs

HFP: High Frequency Power (50 - 200 Hz) measured over 500 ms epochs

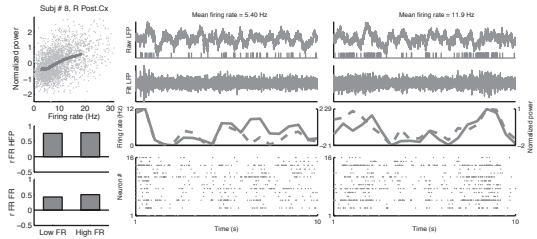
r(FR,HFP): Pearson's correlation between FR and HFP measured over 10 s windows

r(FR,FR): Mean pairwise correlation between FRs of neighboring neurons* measured over 10 s windows

3. Example Superlinear Neuron

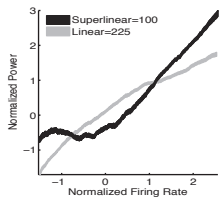


4. Example Linear Neuron

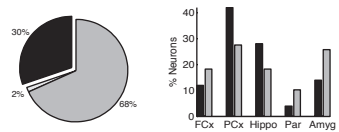


5. Population-level findings

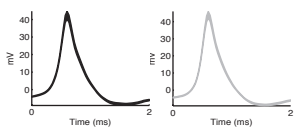
Average FR-HFP function



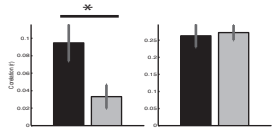
Frequency by anatomical region



Waveforms



FR vs. r(FR,FR) r(FR,HFP) vs. r(FR,FR)



6. Conclusions

We identified more superlinear neurons (n=100), but not more sublinear neurons (n=5), than expected by chance ($\chi^2_2 = 1,047, p < 0.001$)

Greater firing rate-related increases in local correlations (r(FR,FR)) among superlinear than linear neurons (t(131) =2.54,p=0.01)

Neurons' correlations with HFP (r (FR,HFP) reflected their correlations with surrounding neurons r(FR,FR) in the local population[5]

The non-linearity of a neuron's FR-HFP relation may have implications for the computations carried out within local networks

References and Acknowledgements

1. Buzsaki et al. (2012) *Nat. Rev. Nsci* 2. Manning et al. (2009) *J.Nsci* 3. Ray and Maunsell (2011) *PLoS Bio*
4. Quiroga et al . (2004) *Neural Computation* 5. Nir et al . (2007) *Current Biology*

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