1 To-read

- other models/papers to P-units:

  Bastian 1981a Electrolocation I. How the electroreceptors of Apteronotus albifrons code for moving objects and other electrical stimuli

  Benda and Herz (2003)

2 Introduction

2.1 Apteronotus leptorynchus

- to mention: size range, tank conditions,
- continuous sinusoidal electric organ discharge EOD with near constant amplitude and frequency (Moortgat et al. 1998)
- EOD carrier signal for AMs caused by nearby objects like prey or other electric fish

2.2 general P-unit notes

- consist of 25-40 receptor cells and a nerve fiber that makes synaptic contact to at least 16 active neurotransmitter release sites per receptor cell. (M.V.L. Bennett, C. Sandri, K. Akert, Fine Structure of the tuberous electroreceptor of the high-frequency electric "sh Sternachus albifrons (gymnotiformes), J. Neurocytol. 18 (1989) 265.)
- most abundant tuberous receptor
- spikes in probabilistic manner to upward phase of eod
- important characterization P-value probability of spiking per EOD cycle estimated as p-unit frequency divided by eod frequency typical values 0.1-0.6 (Bastian 1981a, Xu et al 1997)
- rapidly adapting (Benda et al 2005, Xu et al. 1996) often studied with SAMs or RAMs
- can predict up to 80% of the AM using reverse correlation and coherence but no obvious decoding mechanism
- linear coders of intensity, additive noise models are suitable Gussin et al. 2007

2.3 Coding

2.4 nerve recordings

- sample descriptions in: Hernriettes phd, Gussin et al. 2007, Benda et al. 2005

3 Mat&Met

3.1 model construction

- explain why adaption current and not a dynamic threshold: chosen AC other possibilities(dyn. thresh. voltage hyperpol.) why AC is better.

4 Paper

4.1 Limits of linear rate coding of dynamic stimuli by electroreceptor afferents

Daniel Gussin, Jan Benda, Leonard Maler, 2007, J neurophysiol

P-units may code for the intensity and slope of the stimulus and if the higher neuronal structures can separate these two parts they can detect the very weak signals they use in their behavior.

4.1.1 Introduction

- definition of neural code needs map between external signal and resulting spike trains AND demonstration that downstream neural circuits can interpret this mapping and therefore direct behavioral output.

  original code often assumed to be linear rate coding needs only temporal summation over some time window to decode

  linear code breaks down for dynamic signals and neurons with time-dependent conductances (adapting currents)!

  then more sophisticated methods like spike-triggered stimulus averages (STA) are used to estimate the linear encoding of signals but no obvious decoding mechanisms are implied.

4.2 Simple models of bursting and non-bursting P-type electroreceptors

Maurice J. Chacron, Andre H Longtin , Leonard Maler, 2001

- simple math. model of P-units for just the baseline behavior.
- uses dynamic threshold, abs refractory period, for bursty cells added a delayed depolarization current
- wasn't "fitted" to data just compared, chosen and fixed(?) parameters

References

Benda, J. and Herz, A. V. (2003). A universal model for spike-frequency adaptation. *Neural computation*, 15(11):2523–2564.