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Random behavior in regular spike times: a phase function to find periodicity in spike time sequences, and its application to globus pallidus neurons

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Real spike time sequences can exhibit considerable variability. Conventional correlation methods [1,2] that require in general long time duration sequences cannot be reliably used to discover frequency components or time constants that might exist at shorter time scales. Recently we introduced a phasefunction method [3] to characterize much shorter duration spike time data, which can show periodicity and time constants present in fewer number of spike times than needed by correlation methods. We use an autophase function to systematically explore the temporal frequencies in spike time sequences recorded from rat globus pallidus neurons of basal ganglia in slices.

Globus pallidus neurons spike spontaneously. The spontaneity can produce rhythmic oscillations over hours of in vitro recordings. However, the spike times are known to have considerable variability among spike times [4,5]. The change in variability can be on the order of seconds. The resultant interspike interval histograms defy conventional classification into gamma distributions, and instead follow approximately log-normal distributions. Application of autophase function method to these spike times reveals strong periodicity at short time scales. Thus it is puzzling that a random distribution can emerge from such strong oscillations. We investigate the changes in periodicity in time in globus pallidus neurons, and the effect of rate on the disruption of their frequency.

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References

1. Moore GP, Perkel DH, Segundo JP: **Statistical analysis and functional interpretation of neuronal spike data.** *Annu Rev Physiol* 1966, **28**:493-522.
2. Brown EN, Kass RE, Mitra PP: **Multiple neural spike train data analysis: state-of-the-art and the future challenges.** *Nature Neurosci* 2004, **7**:456-461.
3. Dodla R, Wilson CJ: **A phase function to quantify serial dependence between discrete samples.** *Biophys J* 2010, **98**:L5-L7.
4. Stanford IM: **Independent neuronal oscillators of the rat globus pallidus.** *J Neurophysiol* 2003, **89**:1713-1717.
5. Deister CA, Chan CS, Surmeier DJ, Wilson CJ: **Calcium-activated SK channel voltage-gated ion channels to determine the precision of firing in globus pallidus neurons.** *J Neurosci* 2009, **29**:8452-8461.

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