Comparison of variability and randomness in stationary neuronal firing

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Abstract

One of the most important characteristics of the neuronal firing (besides the mean ISI) is its variability, which is often measured by the coefficient of variation (C_V). However, the patterns of neuronal activity can be different even if the variability (C_V) is fixed. Thus we suggest to take into account the notion of randomness measured by the normalized entropy. We analyze the variability and randomness for four ISI distributions. The first two of them are common statistical descriptors – gamma and log-normal distributions. The remaining two result from simple neuronal models – Wiener process with drift and Ornstein-Uhlenbeck process. Furthermore, we search for the maximum randomness of firing in dependence on its variability. For $C_V < 1$ the maximum random ISI model is described by the renormalized Gaussian distribution, for $C_V = 1$ it is given by the exponential model and for $C_V > 1$ no unique model exists. Finally, the relation between normalized entropy and the Kullback-Leibler distance from the maximum entropy distribution is shown. The presented results extend our previous studies on this topic [1–4].

References

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