Multiple spike time patterns occur at bifurcation points of membrane potential dynamics

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Abstract

Introduction

The response of a neuron to fluctuating currents in vitro often yields a reliable and precise firing pattern, indicating a membrane potential profile that is capable of sustaining multiple spike patterns across a range of stimulus amplitudes. The response obtained across trials can be interpreted as an ensemble of cell responses to the same stimulus, which is a result of the interplay between cell properties and network connectivity. However, at exceptional values called bifurcation points, large shifts in the spike times were observed. To understand the nature of these shifts, we investigated the spike times for different conditions that might occur in vivo, such as changes in the number of events, stimulus amplitudes, and network connectivity. The results obtained in response to small changes in the stimulus and multiple spike patterns were analyzed. Our findings indicate that the redundancy in the firing pattern is essential to robustness, and that the threshold for a shift in the spike times is similar for different conditions that might occur in vivo.

Discussion

1. In vitro data show evidence for bifurcation points, which correspond to a transient reduction in the R-reliability as a function of stimulus parameter. Bifurcation points could improve information content of spike trains because it combines spike times with an intermediate precision that is still high enough to be effective postsynaptically with an increase in the number of events thereby providing better coverage of the ‘interesting’ features of the stimulus time course.

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Conclusion

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References


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