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Firing map for integrate–and–fire models with almost periodic stimulus

In integrate–and–fire systems the sequence of consecutive spikes can be recovered via iterations of the so–called firing map. Until now analytical approaches mainly concentrated on models of the type $\dot{x} = f(t, x)$ when the function f was continuous and periodic in the time variable ([1],[2],[3]). We analyze firing maps and firing sequences for the class of integrate–and–fire models with the stimulus function almost periodic in time (either uniformly almost periodic or in a Stepanov sense) and prove that many required properties of the firing map still hold for leaky integrate-and fire $\dot{x} = -\sigma x + f(t)$ or Perfect Integrator $\dot{x} = f(t)$ models when the function f is only locally integrable. We prepare a formal framework for the study of discrete dynamics of the firing map arising from almost periodically driven integrate–and–fire systems. In particular, results concerning almost periodic displacement of the firing map and regularity properties (semi–/almost periodicity) of the sequence of interspike intervals will be shown.

References

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