

A simple integrate-and-fire model for RSA

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The simple caricature of an excitable system (one neuron, the heart) called Integrate-and-Fire (IF) model has been thoroughly investigated, as it is able to mimic some features of the experimental systems, in particular the phase-locking of the output discharge to periodic input signals.

Actually, many varieties of IF have been considered: deterministic, with or without leakage, input or threshold modulated, stochastic, over or sub threshold (the last, in relation to the Stochastic Resonance). We just remind the reader that the bare model with sinusoidal driving on the input signal does not account for stable phase-locking behaviour; that can be obtained by setting a leakage in the integration, so yielding the leaky integrate-and-fire model, but also applying the periodic signal on the threshold (Glass and Mackey, 1979, Glass et al., 1980).

Recently, a modification of the stochastic version of the Glass model (a periodic but not purely sinusoidal firing threshold) has been proposed to mimic the main features of Heart Rate Variability and in particular the Respiratory Sinus Arrhythmia, in healthy subjects at rest (Barbi et al., 2005). Herein, after summarising those results, we perform an analysis of the phase-locking behaviour both of the bare and the noisy version of the proposed model and discuss its implications with regard to the phase synchronisation of heart beating to the respiratory activity.

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