Optical systems

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Abstract

The development of stochastic resonance took a large leap forward when its potential relevance for neurophysiological processes had been recognized. Longtin, Bulsara, and Moss observed that interspike interval histograms of periodically stimulated neurons exhibit a remarkable resemblance to residence-time distributions of periodically driven bistable systems.

1. Introduction

In this section, we report on the relevant neurophysiological experiments and describe how stochastic resonance enters naturally into standard models for neuronal dynamics. By now, stochastic resonance is a well accepted paradigm in the biological and neurophysiological sciences, and several recent reviews on neurophysiological applications of stochastic resonance are available [1].

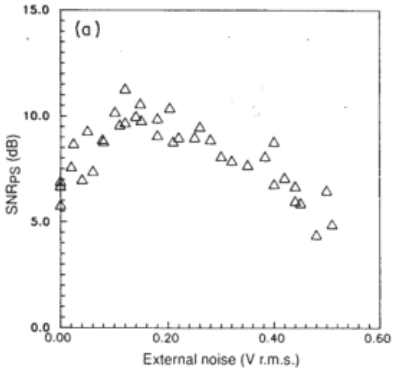

Figure 1. 23 Bistable ring laser

2. Neurophysiological background

There is a large variety of types of neurons in the nervous system of animals and humans with variations in structure, function, and size. Let us restrict ourselves here to a canonical neuron, which presents the underlying functional skeleton for all neurons. The canonical neuron

	1	2	3	4	5	6	7
Alphabet	A	B	C	D	E	F	G
Roman	I	II	III	IV	V	VI	VII

Table 1. Results. Ours is better.

is divided into three parts, an input part, a processing part, and a signal transmission part [2].

$$x' = x - x^3 + u(t) + A_0 cos(st) \tag{1}$$

3. Neuron firing and Poissonian spike trains

Wiesenfeld, Pierson, Pantazelou, Dames, and Moss proposed a very elegant approximate theory for modeling neuron firing in the presence of noise and a periodic stimulus. The neuron emits uncorrelated, sharp spikes at random times t n . The spiking rate, however, is inhomogeneous, i.e., sinusoidally modulated. This sort of process is described by the theory of inhomogeneous Poissonian point processesłsee [3].

References

[1] R. Benzi, G. Parisi, A. Sutera, and A. Vulpiani. A theory of stochastic resonance in climatic change. *Siam Journal on Applied Mathematics*, 43(3):565–578, 1983. 1

[2] L. Gammaitoni, F. Marchesoni, and S. Santucci. Stochastic resonance as a bona fide resonance. *Physical Review Letters*, 74(7):1052–1055, 1995. 1

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