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Subharmonic stochastic synchronization and resonance in neuronal systems

Abstract
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We study the response of a model neuron, driven simultaneously by noise and at least two weak periodic signals. We focus on signals with frequencies components kf_0,$(k+1)f_0$,…$(k+n)f_0$ with $k>1$. The neuron's output is a sequence of pulses spaced at random interpulse intervals. We find an optimum input noise intensity for which the output pulses are spaced $1/f_0$, i.e., there is a stochastic resonance (SR) at a frequency missing in the input. Even higher noise intensities uncover additional, but weaker, resonances at frequencies present in the input. This is a different form of SR whereby the most robust resonance is the one enhancing a frequency, which is absent in the input, and which is not possible to recover via any linear processing. This can be important in understanding sensory systems including the neuronal mechanism for perception of complex tones.