Model of bistability and inverse stochastic resonance of Purkinje cell

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Purkinje neurons play an important role in Cerebellar computation. Their axons are the only projection from the cerebellar cortex to deeper cerebellar structures. These neurons appear to have a type II excitability, which can be revealed by a discontinuity in their F-I curves. This intrinsic membrane property of the Purkinje cells implies bistable behavior that can underly bimodality observed *in vivo*. This feature is tested experimentally by measuring the frequency hysteresis in response to slow ramp of current. Another effect recently found for the continuous neuronal models is the inhibition of firing by external noisy input, so called inverse stochastic resonance. We found similar phenomena measured in Purkinje cells. An adaptive Exponential Integrate-and-Fire model with adaptation is proposed to explain such properties. This model reproduces the bistability and inverse stochastic resonance observed experimentally. In this work we present experimental results and bifurcation analysis of the model explaining these two effects. We found numerically the optimal amplitude and optimal correlation of the noise stimuli for inhibition. We propose that such tuning is directly linked to the switching between quiescent and spiking state of Purkinje neurons revealing definitively their bistability.