Optimal Channel Efficiency in a Sensory Network

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We show that the entropy of the distribution of avalanche lifetimes in the Kinouchi-Copelli model always achieves a maximum jointly with the dynamic range. This is noteworthy and nontrivial because while the dynamic range is an equilibrium average measure of the sensibility of a sensory system to a stimulus, the entropy of relaxation times is a purely dynamical quantity, independent of the stimulus rate, that can be interpreted as the efficiency of the network seen as a communication channel. The newly found optimization occurs for all topologies we tested, even when the distribution of avalanche lifetimes itself is not a power-law and when the entropy of the size distribution of avalanches is not concomitantly maximized, strongly suggesting that dynamical rules allowing a proper temporal matching of the states of the interacting neurons is the key for achieving good performance in information processing, rather than increasing the number of available units.

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