Optimal Energy Allocation in Reliable Neural Sensory Processing

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Presentation Abstract Summary The optimization approach to neurobiology has yielded principles derived from information-theoretic study of information transmission and storage that explain several experimentally-measured physical properties of the brain. Computational neuroscience, however, typically tries to explain neural function by developing specific computational circuits and architectures that are biologically plausible. In this work, we show how emerging results in the information-theoretic study of reliable computation may be used to derive theoretical predictions on optimal energy allocation to noisy neurons in sensory processing and how these optimality hypotheses may be tested with experimental data. In particular, we use the information propagation technique developed by Pippenger and further optimization to derive optimal energy allocation in feedforward neural networks with neurons that have energy-dependent failure rates. The same theoretical approach has also been used to optimize energy allocation in deep neural networks
implemented in nanoscale device technologies.

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