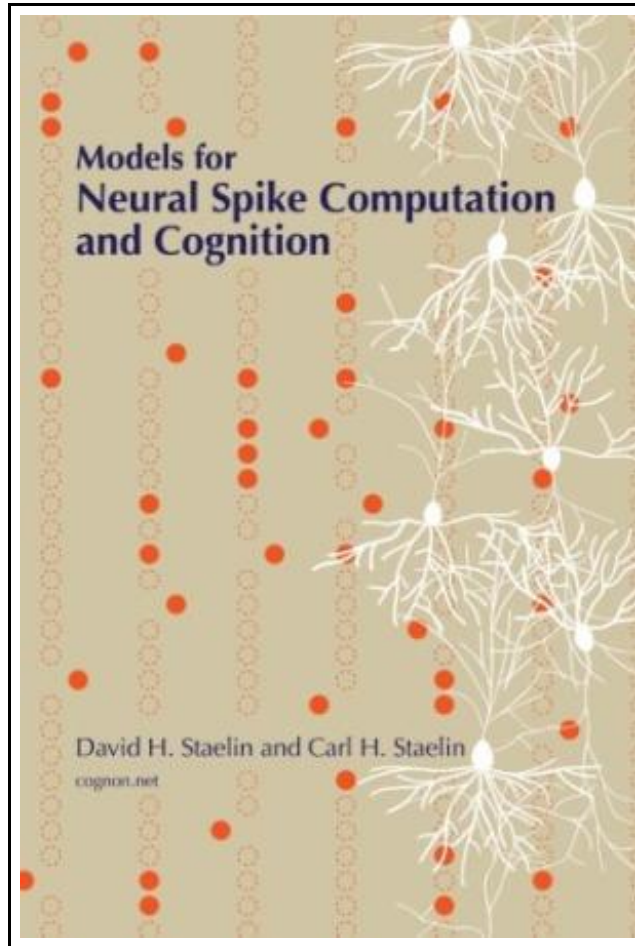# Models for Neural Spike Computation and Cognition

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Reviews

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MODELS FOR NEURAL SPIKE COMPUTATION AND COGNITION

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Createspace, United States, 2011. Paperback. Book Condition: New. 229 x 150 mm. Language: English . Brand New Book ***** Print on Demand *****.This monograph addresses the intertwined mathematical, neurological, and cognitive mysteries of the brain. It first evaluates the mathematical performance limits of simple spiking neuron models that both learn and later recognize complex spike excitation patterns in less than one second without using training signals unique to each pattern. Simulations validate these models, while theoretical expressions validate their simpler performance parameters. These single-neuron models are then qualitatively related to the training and performance of multi-layer neural networks that may have significant feedback. The advantages of feedback are then qualitatively explained and related to a model for cognition. This model is then compared to observed mild hallucinations that arguably include accelerated time-reversed video memories. The learning mechanism for these binary threshold-firing cognon neurons is spike-timing-dependent plasticity (STDP) that depends only on whether the spike excitation pattern presented to a given single learning-ready neuron within a period of milliseconds causes that neuron to fire or spike. The false-alarm probability that a trained neuron will fire for a random unlearned pattern can be made almost arbitrarily low by reducing the number of patterns learned by each neuron. Models that use and that do not use spike timing within patterns are evaluated. A Shannon mutual information metric (recoverable bits/neuron) is derived for binary neuron models that are characterized only by their probability of learning a random input excitation pattern presented to that neuron during learning readiness, and by their false-alarm probability for random unlearned patterns. Based on simulations, the upper bounds to recoverable information are 0.1 bits per neuron for optimized neuron parameters and training. This information metric assumes that: 1) each neural spike indicates only that the responsible neuron input excitation pattern...

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