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Presentation Abstract

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Presentation Title:	Feedback connections stabilize propagation of synchronous spiking in cortical neural networks
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Topic:	++G.06.b. Network models
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Abstract:	Precisely timed action potentials have been related to stimuli and behavior in monkeys, indicating that the neural coding may be based on precise spike timing of cortical neurons, synfire chains. An assumption that sensory information may be encoded by precise spike timing has been challenged by the critical question of whether synfire chains can successfully propagate through hierarchies of cortical areas. It is possible that noise would destroy millisecond precision during transmission of synfire chains through many layers of cortical networks. Previous studies demonstrated that synfire chains can propagate through the layers of a feedforward network. In the feedforward models, a spike precision sharpens as it propagates through the network. A separatrix divides the state space into two areas: stable and unstable. In the stable area, all trajectories converge into an attractor state representing successful propagation of synfire chains, and neural activity starting anywhere inside this area reaches a stable state with millisecond precision. Synfire chains starting outside the stable area decay after a few steps of transmission. These observations suggest that only strong enough stimuli, which

evoke high number of spikes would successfully propagate through the cortical layers without degradation of temporal precision, while neural activities that are too weak will die out. Here we show that inclusion of feedback connections into a feedforward model enhanced propagation of synfire chains through the network layers, while preserving temporal precision. The enhancement of synfire chains propagation was due to feedback inputs increasing the number of spikes in the synfire chains. This moved the initial state of the stimulus into the basin of attractor representing successful synfire chains propagation. In addition, the feedback inputs changed the position of the separatrix, moving it downward and, therefore, increasing the basin of the attractor of the propagation regime.

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COMPUTATIONAL MODEL

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