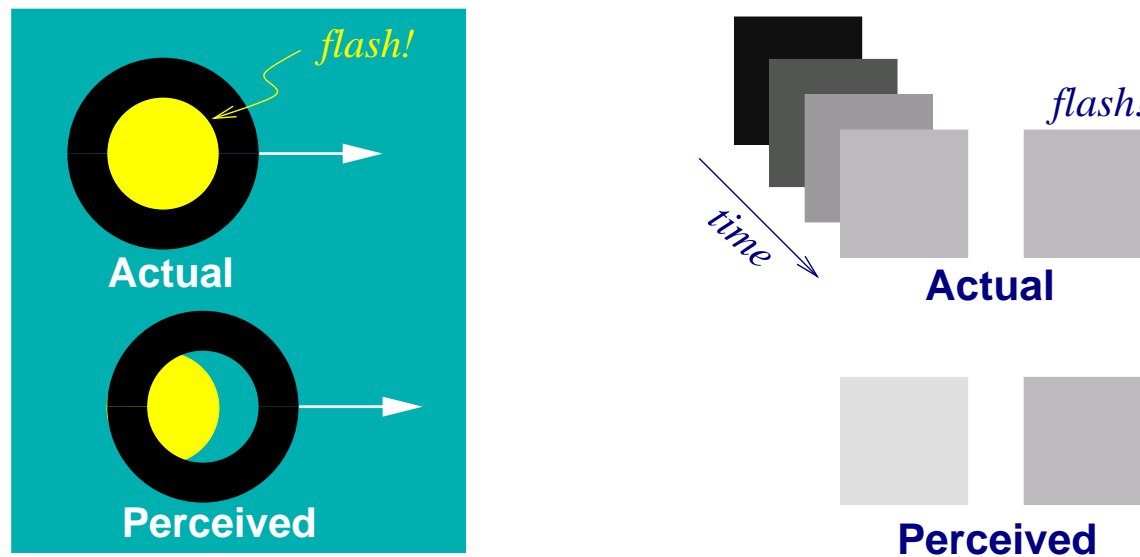


Facilitatory Neural Dynamics for Extrapolation and Delay Compensation

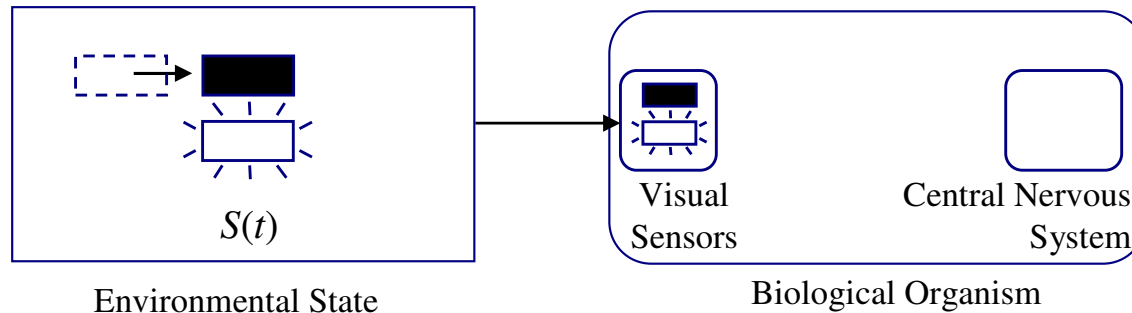
Heejin Lim and Yoonsuck Choe, Texas A&M University



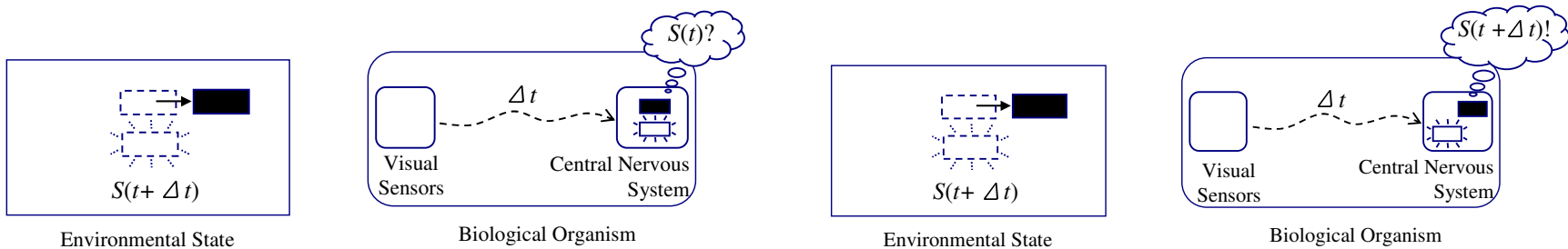
Research Question and Potential Answer:

- **Q:** Why do flash-lag effects occur, and what are their neural mechanisms?
- **A:** To **compensate** for neural conduction **delay** through predictive extrapolation. **Facilitating synapses** may play an important role.

Method: Facilitatory Activation Model



(a) Initial input arriving at the periphery



(b) Without extrapolation: lag in perception

(c) With extrapolation: up-to-date perception

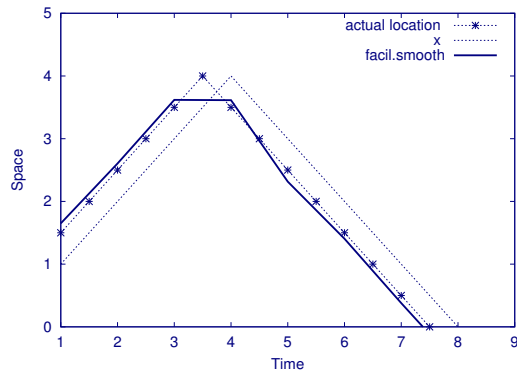
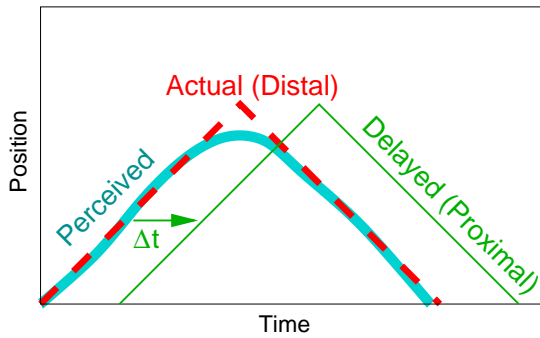
- Extrapolation needed for delay compensation:

$$X_{t+1} = X_t + c \times \Delta X$$

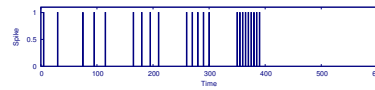
- Two models of extrapolation through synaptic facilitation:

- Firing-rate: straight-forward extrapolation on activity.
- Spike-based: use facilitating synapse model.

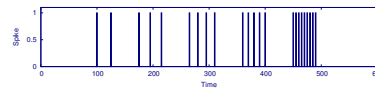
Main Results



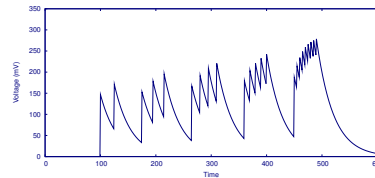
(a) Motion reversal experiment



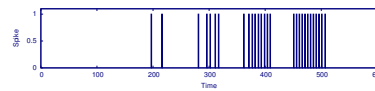
Periphery



Input spikes

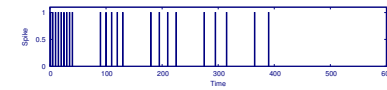


Postsynaptic membrane potential

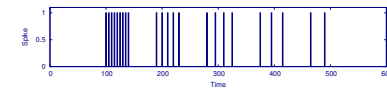


Output spikes

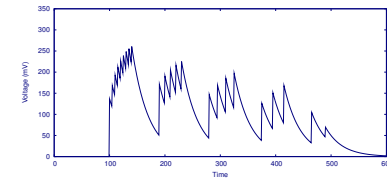
(b) Increasing Firing Rate



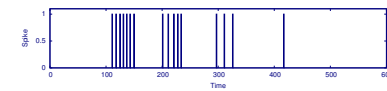
Periphery



Input spikes



Postsynaptic membrane potential



Output spikes

(c) Decreasing Firing Rate

- facilitatory activation model fits motion reversal FLE data.
- Spike-based model fits luminance FLE data.
- **Conclusion:** (1) FLE may occur due to delay compensation, and (2) facilitating synapses may play a role.