Bayesian Inference and Online Experimental Design for Mapping Neural Microcircuits

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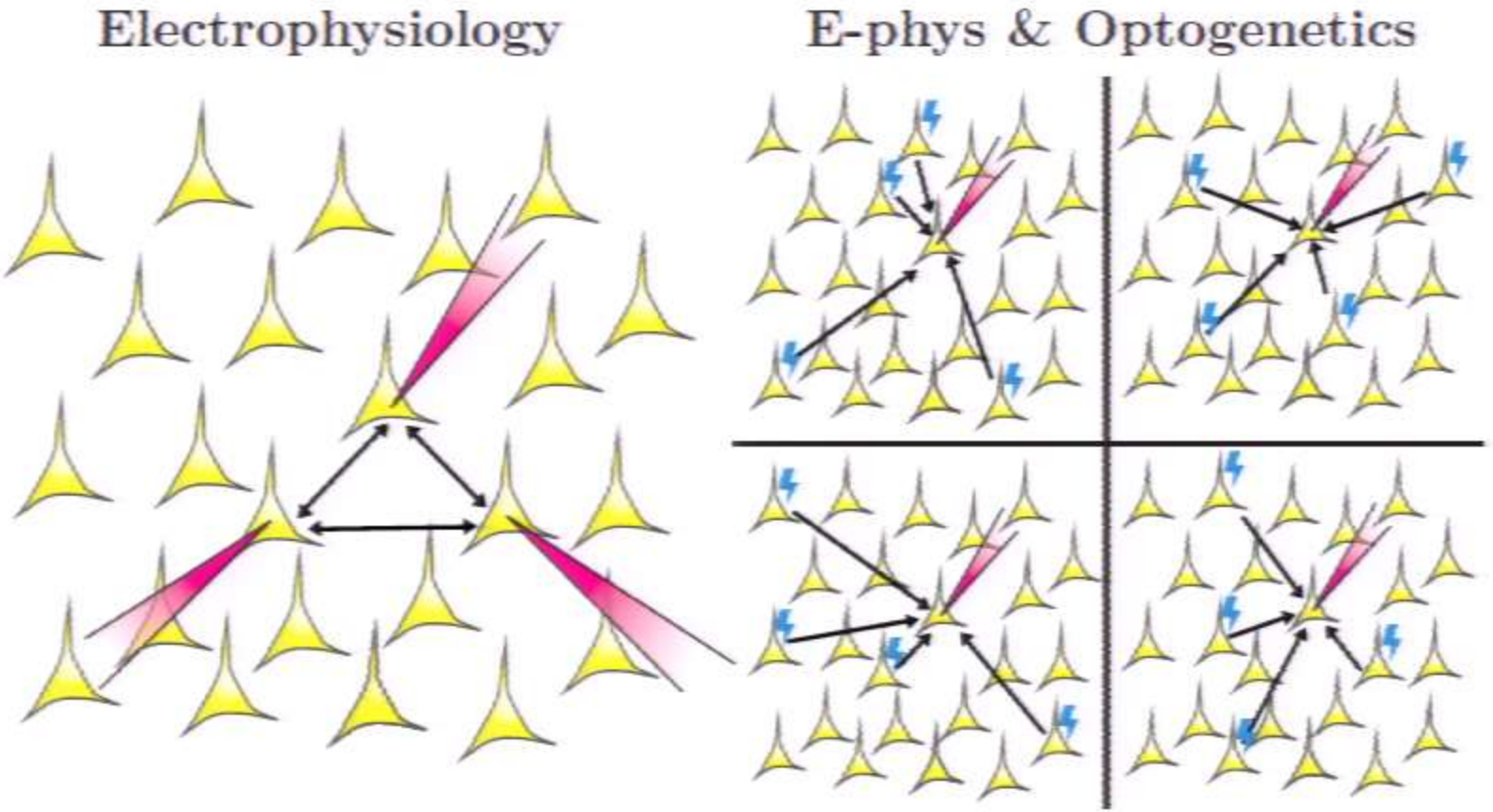
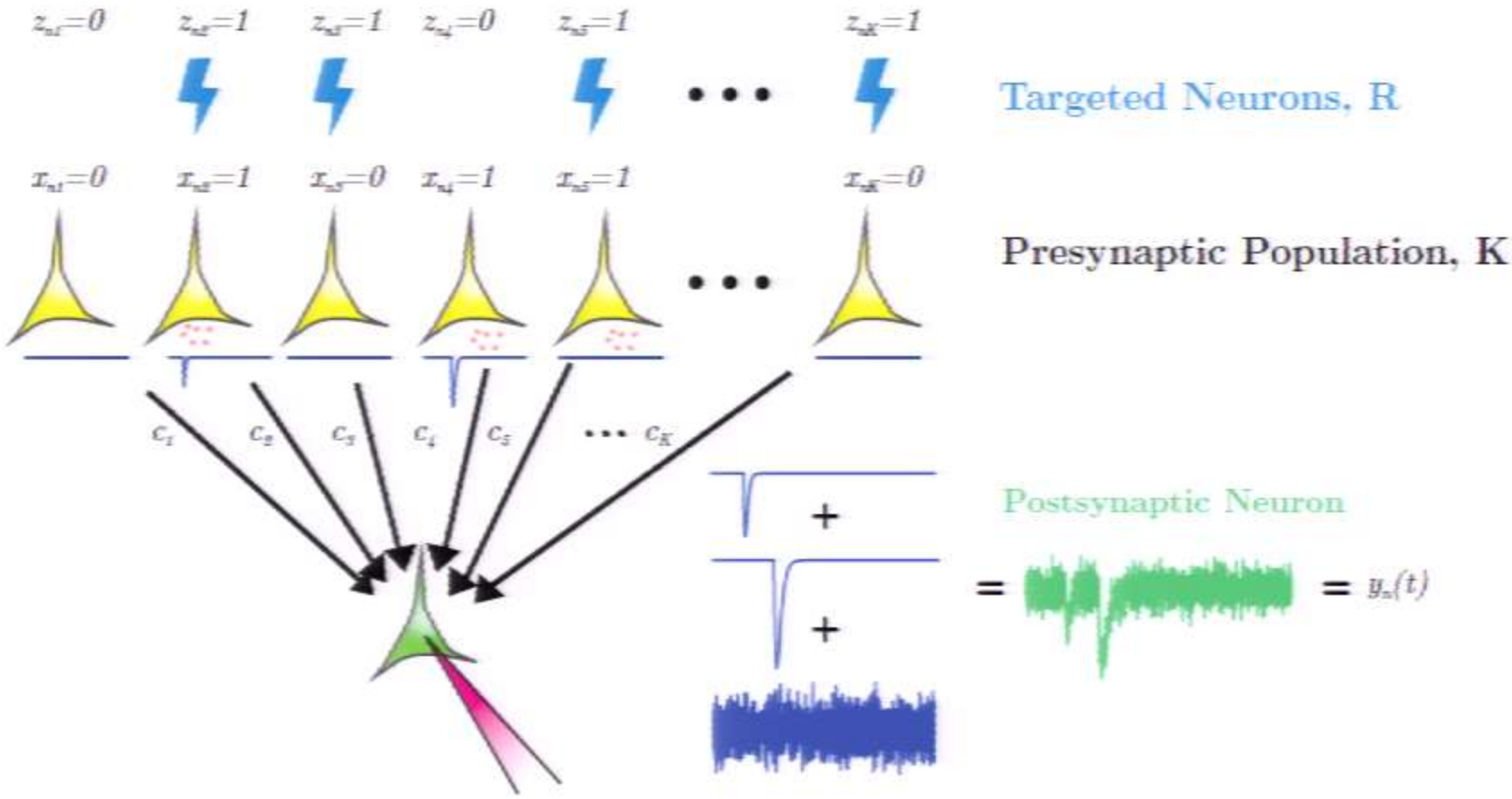
Sat18



Modeling The Experiment



- not all neurons we attempt to fire release neurotransmitter
- some neurons near those we attempt to fire may fire
- c, vector of connection strengths is sparse

Bayesian Inference & Optimal Adaptive Closed-Loop Experimental Design

- Spike-and-slab prior on the synaptic strengths, c
  - incorporates prior information about sparse connections, cell types, locations, etc.
- Goal: choose stimuli to minimize posterior entropy of c
- Use variational inference for speed during optimization
  - need decisions in < 1 second
  - factorized approximation is justified
- Developed effective heuristics for optimizing entropy objective

Real-time adaptive design is feasible.

Optimal Design Significantly Speeds Up Convergence in Simulations