Hebbian and non-Hebbian plasticity orchestrated to form and retrieve memories in spiking networks

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Classic learning rules fail to maintain memories

Induction timescales of plasticity

Online learning of repeating stimuli

Memory recall and working memory

Orchestrated plasticity

Interplay of firing rate and weight dynamics

Spiking network model

Summary

- Local Hebbian and non-Hebbian learning rules interact on a short timescale to stabilize plasticity.
- Multiple stable equilibrium points stabilize background and recall states respectively.
- Consolidation key to heterosynaptic plasticity without overwriting of memories.
- Homeostasis acts on much longer timescales and establishes fine-tuning.

Classic learning rules fail to maintain memories

Problems: Run-away activity and crosstalk between memories.

Induction timescales of plasticity

- Short term plasticity
- Long-term plasticity
- Homeostatic plasticity

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Summary

Effect on pairing protocols is small.

Homeostatic plasticity
Rapid scaling
Ibata et al. 2008
Need fast compensatory mechanisms.

Plasticity induction

Model qualitatively reproduces results from postsynaptic tetanization protocols in Osen et al. (2015). Effect on pairing protocols is small.

References

- Christie & Abraham 1992
- Turrigiano et al. 1998
- Huang et al. 1997
- Zhang et al. 1998
- Homeostatic plasticity
- Ibata et al. 2008
- Need fast compensatory mechanisms.

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