SYDE 556/750

Simulating Neurobiological Systems
Lecture 6: Recurrent Dynamics

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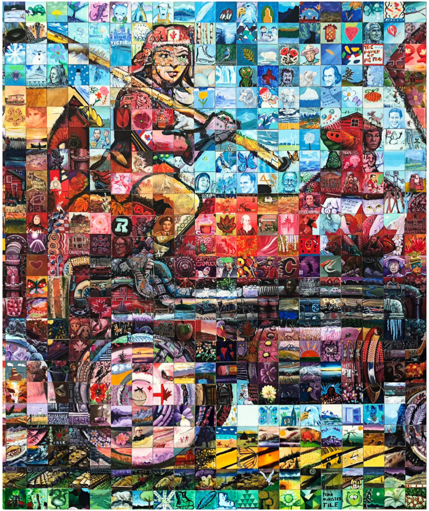
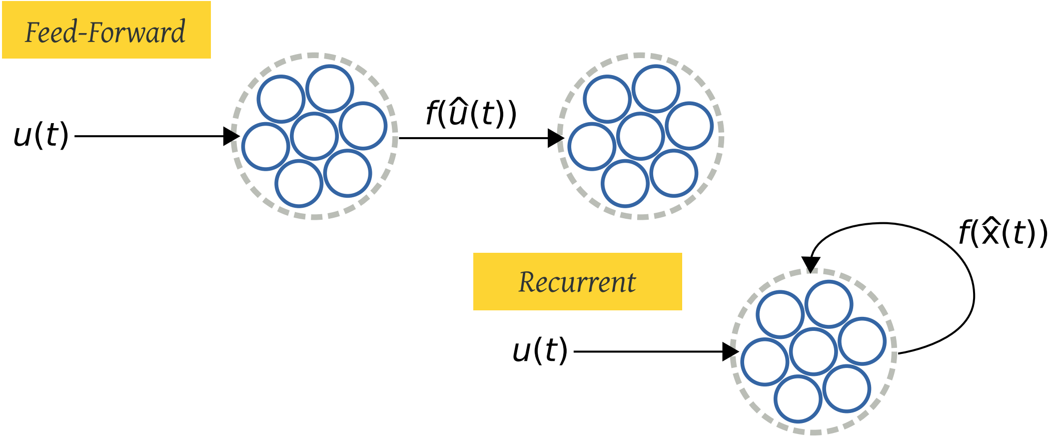
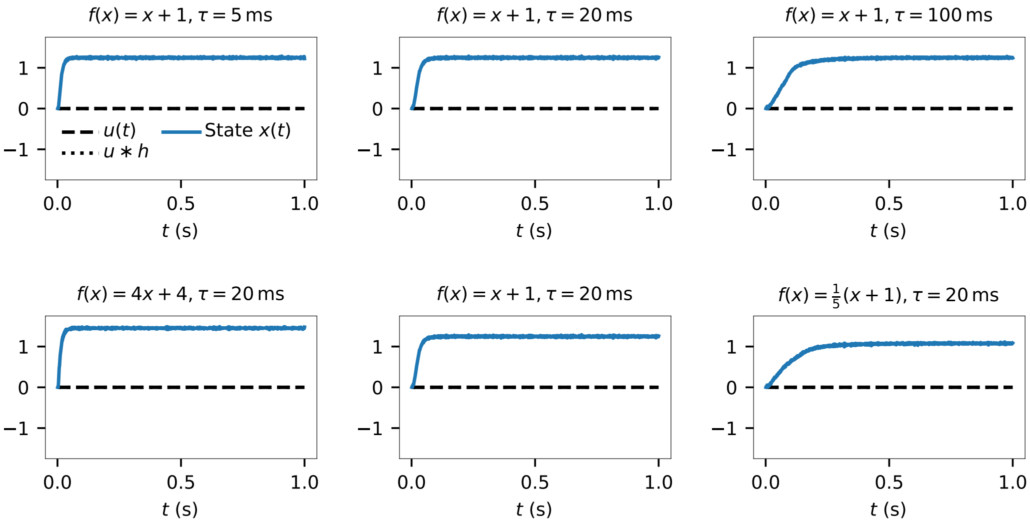


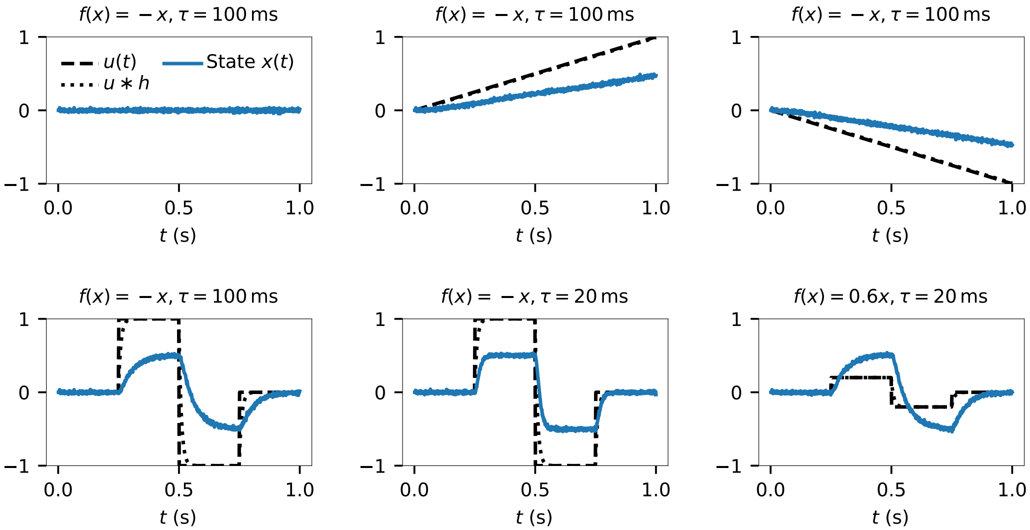
Feed Forward vs. Recurrent Connections



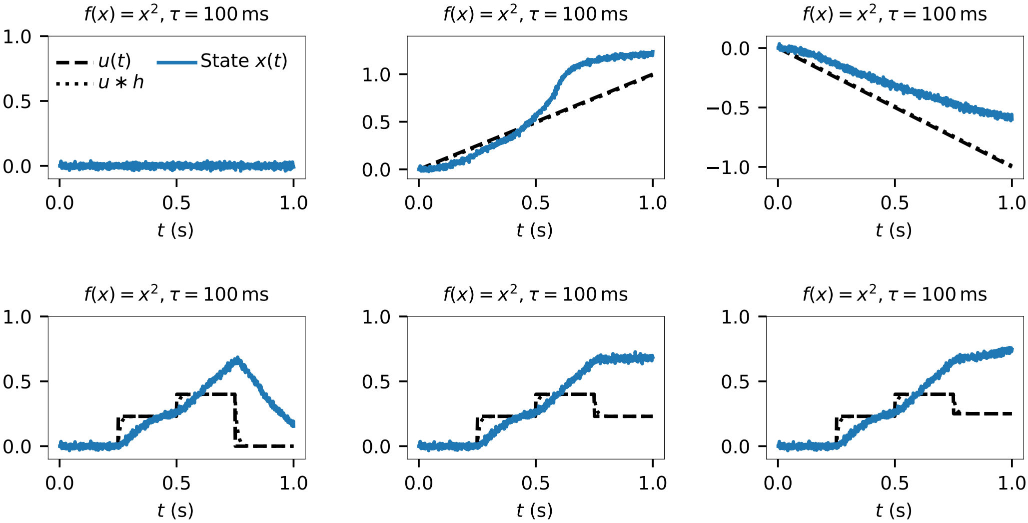
Recurrence Experiments (I)



Recurrence Experiments (II)



Recurrence Experiments (III)



NEF Principle 3: Dynamics

Time-Invariant Dynamical System

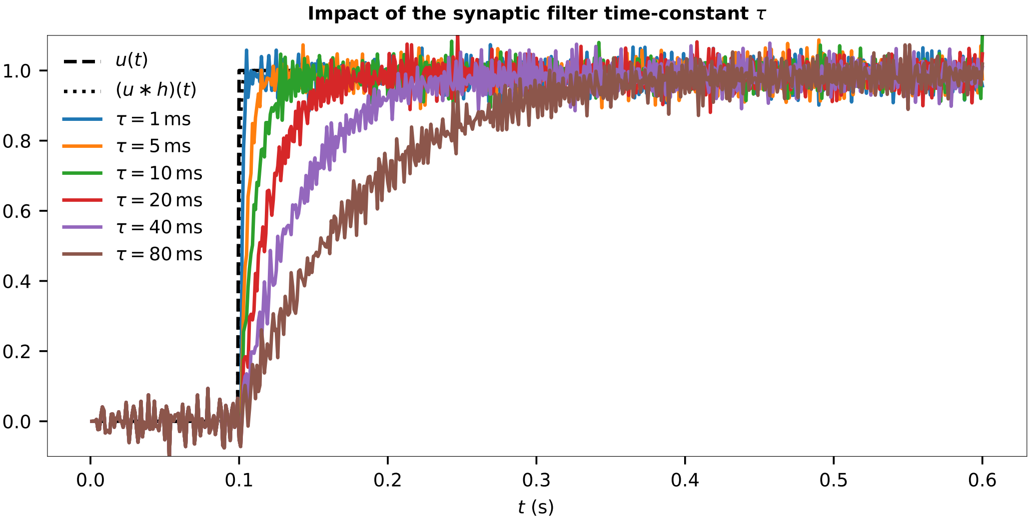
$$\frac{\mathrm{d}\mathbf{x}(t)}{\mathrm{t}} = f(\mathbf{x}(t), \mathbf{u}(t))$$

Linear Time-Invariant (LTI) Dynamical System

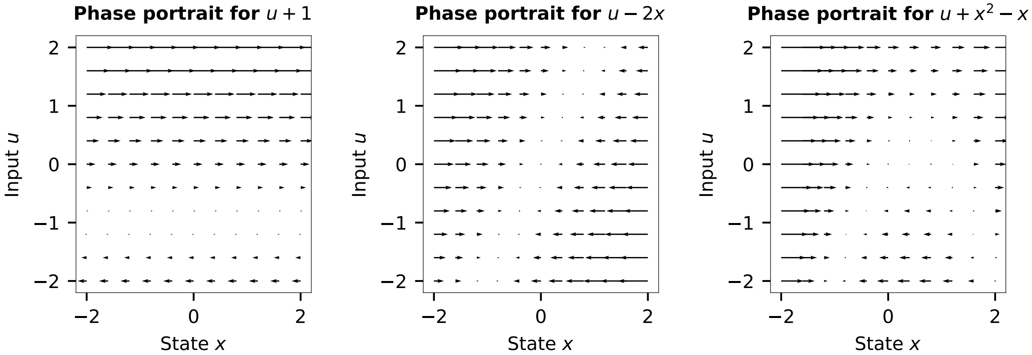
$$\frac{\mathrm{d}\mathbf{x}(t)}{\mathrm{t}} = \mathbf{A}\mathbf{x} + \mathbf{B}\mathbf{u}$$

NEF Principle 3 – Dynamics
Neural dynamics are characterized by considering neural representations as control theoretic state variables. We can use control theory (and dynamical systems theory) to analyse and construct these systems.

Making Sense of Dynamics

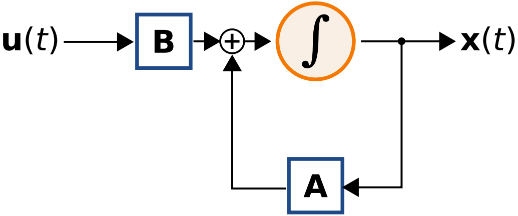


Phase Portraits



Implementing Dynamics using a Neural Ensemble

Evaluating an LTI
using an Integrator



Evaluating an LTI
using a Synaptic Filter

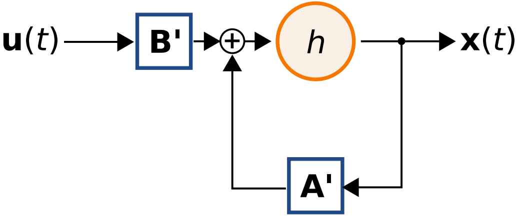


Image sources

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