

Soft-actor-critic for model-free reinforcement learning of eye saccade control

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Introduction

Objective:

- Learn the open-loop horizontal saccadic control of a biomimetic eye using reinforcement learning (soft-actor-critic algorithm)

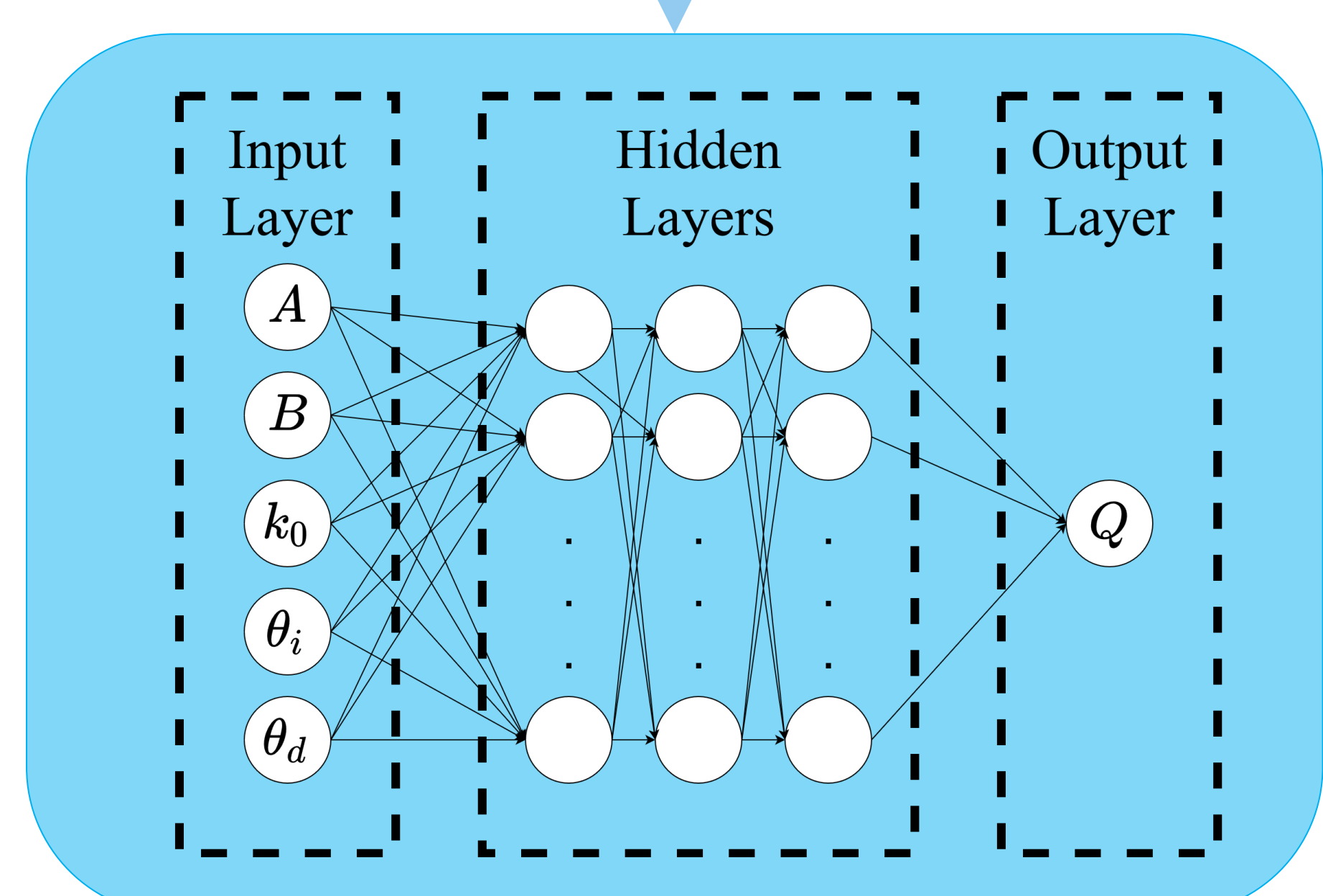
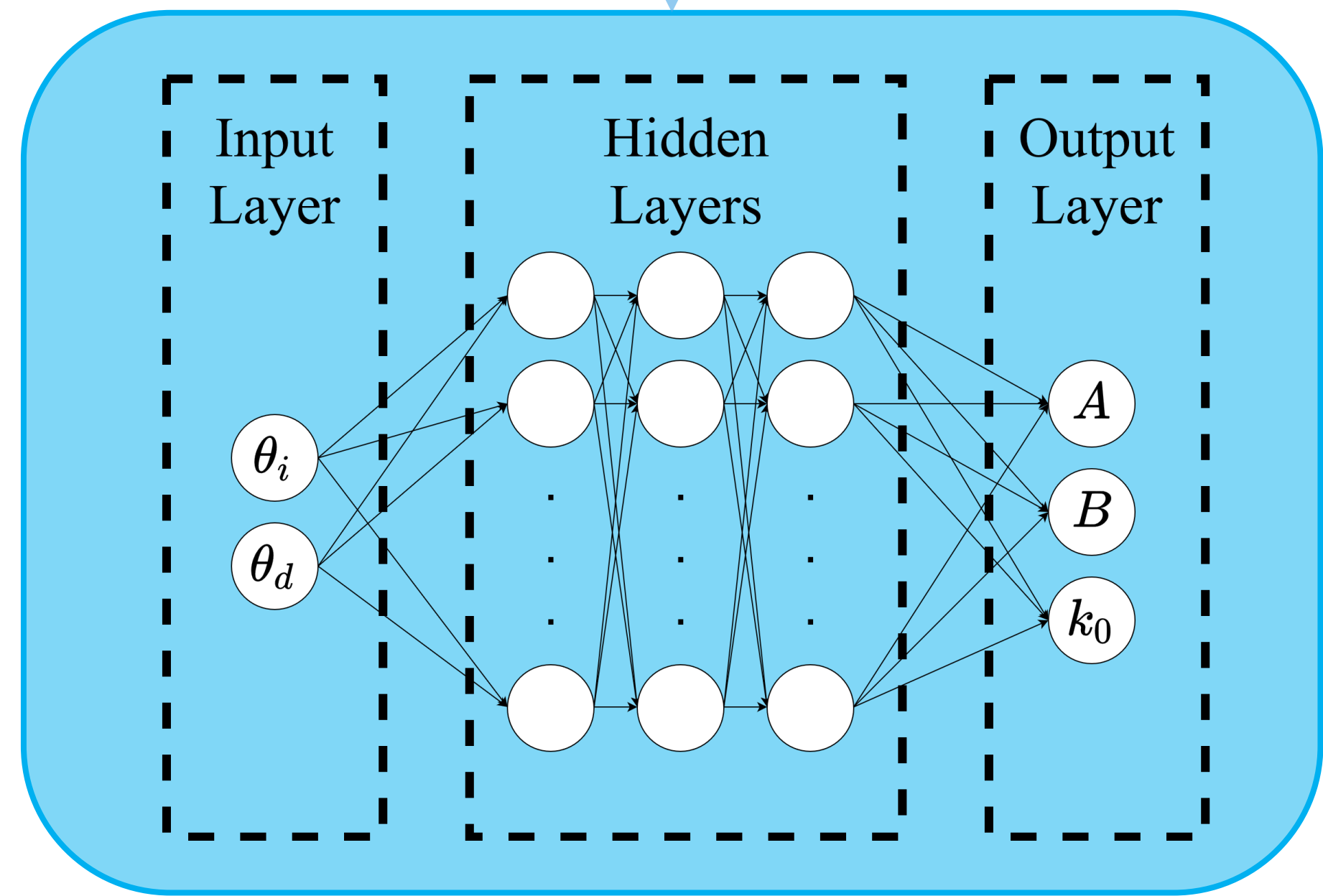
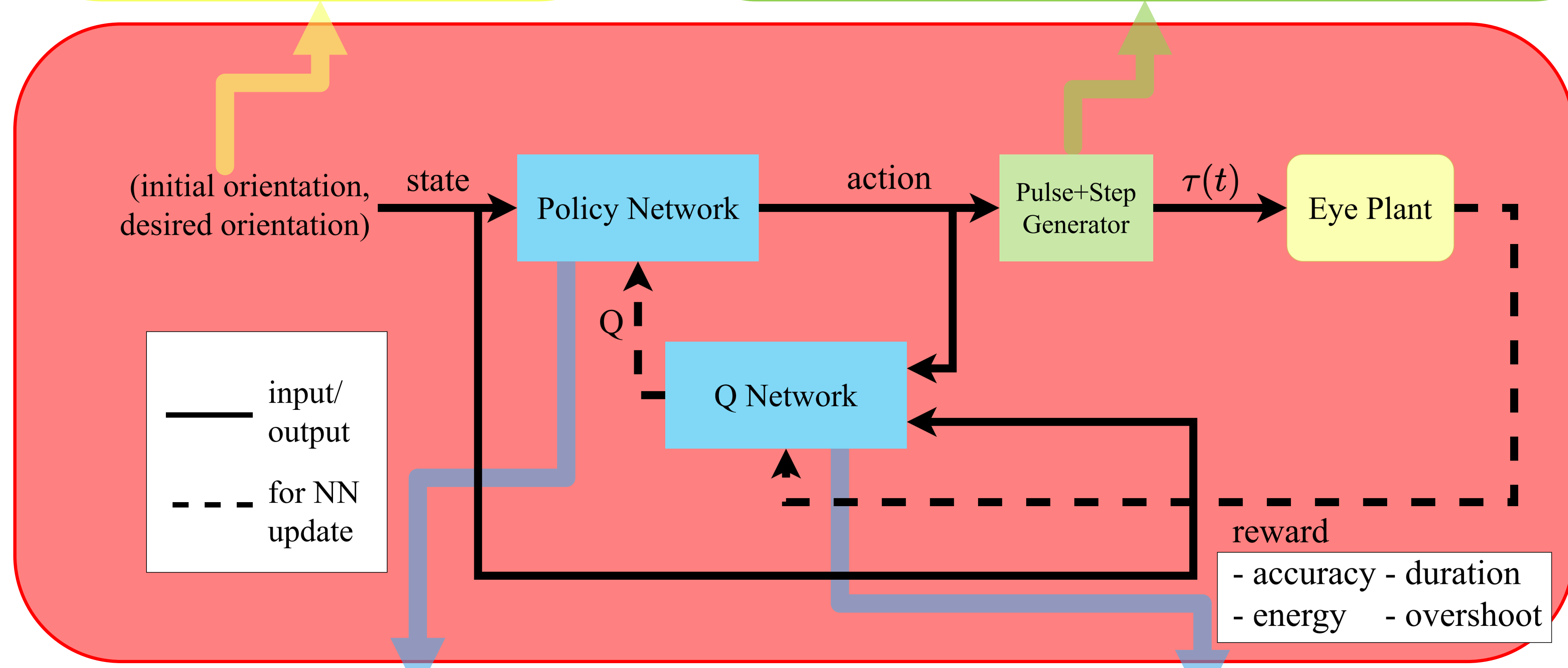
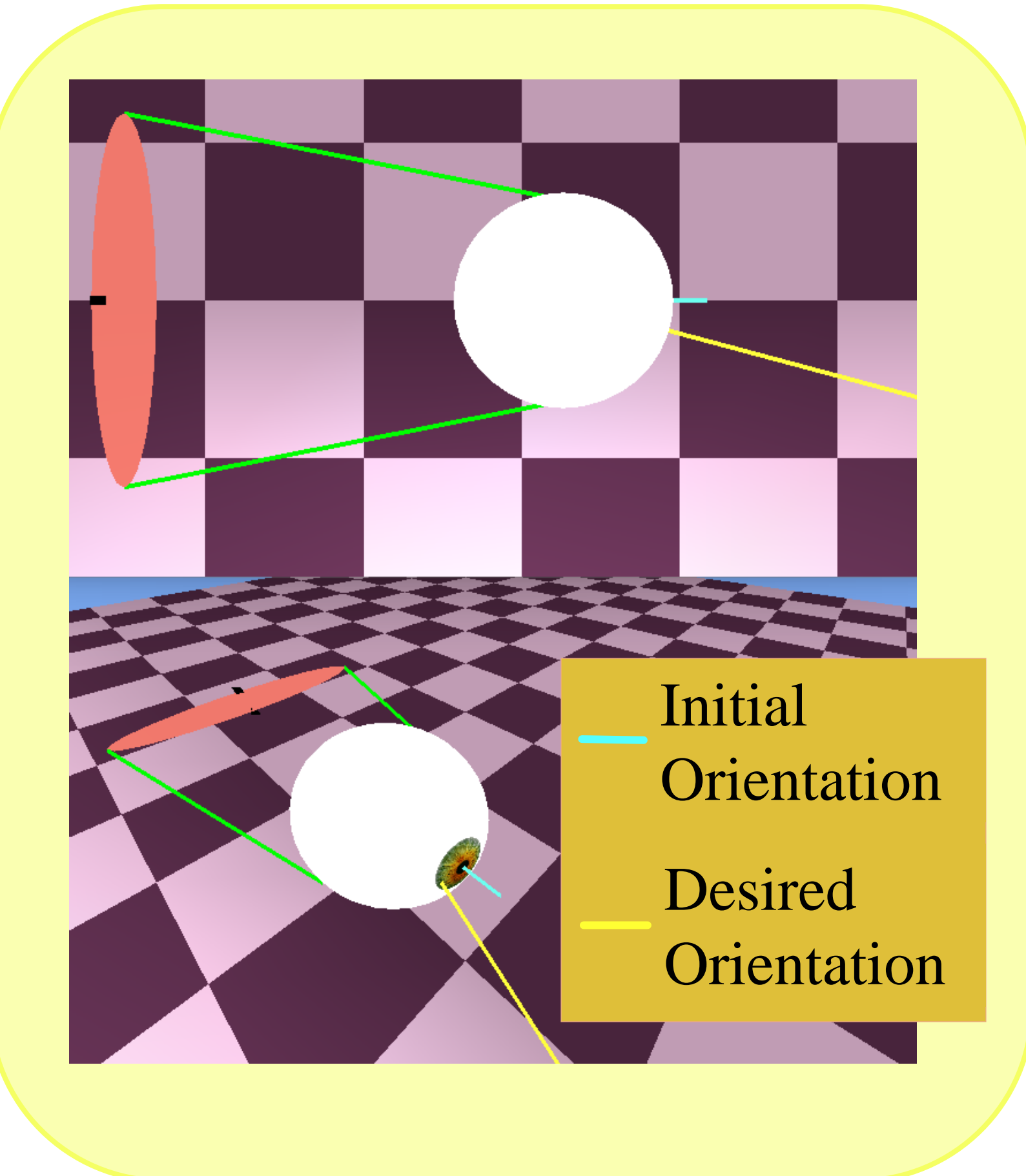
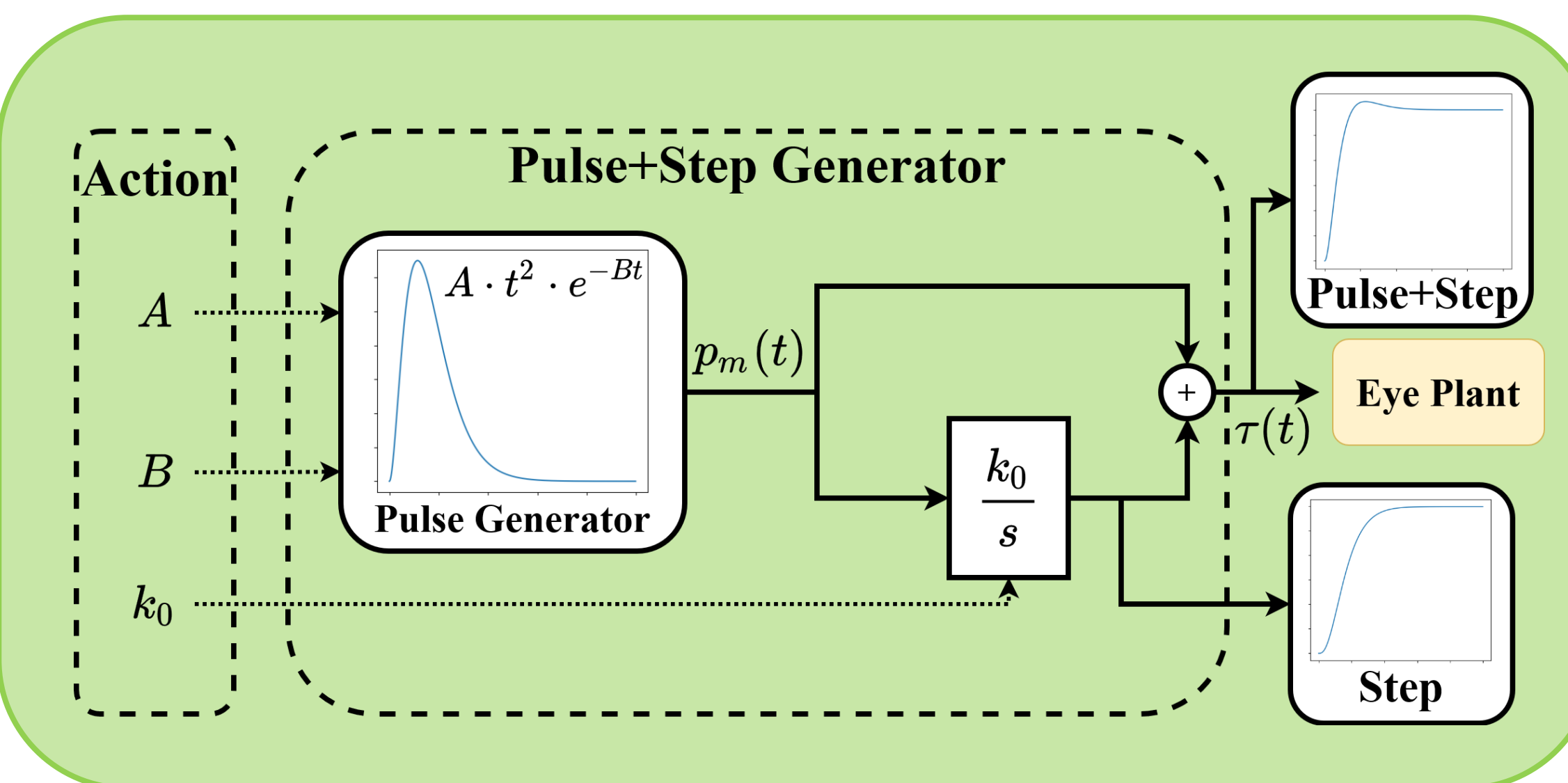
Saccades: rapid eye movements to change gaze direction

Eye Plant:

- Components: motor, rod, elastics, eye
- Overdamped
- 1 Degree of Freedom (Yaw)
- Simulation of Rigid-Body Dynamics

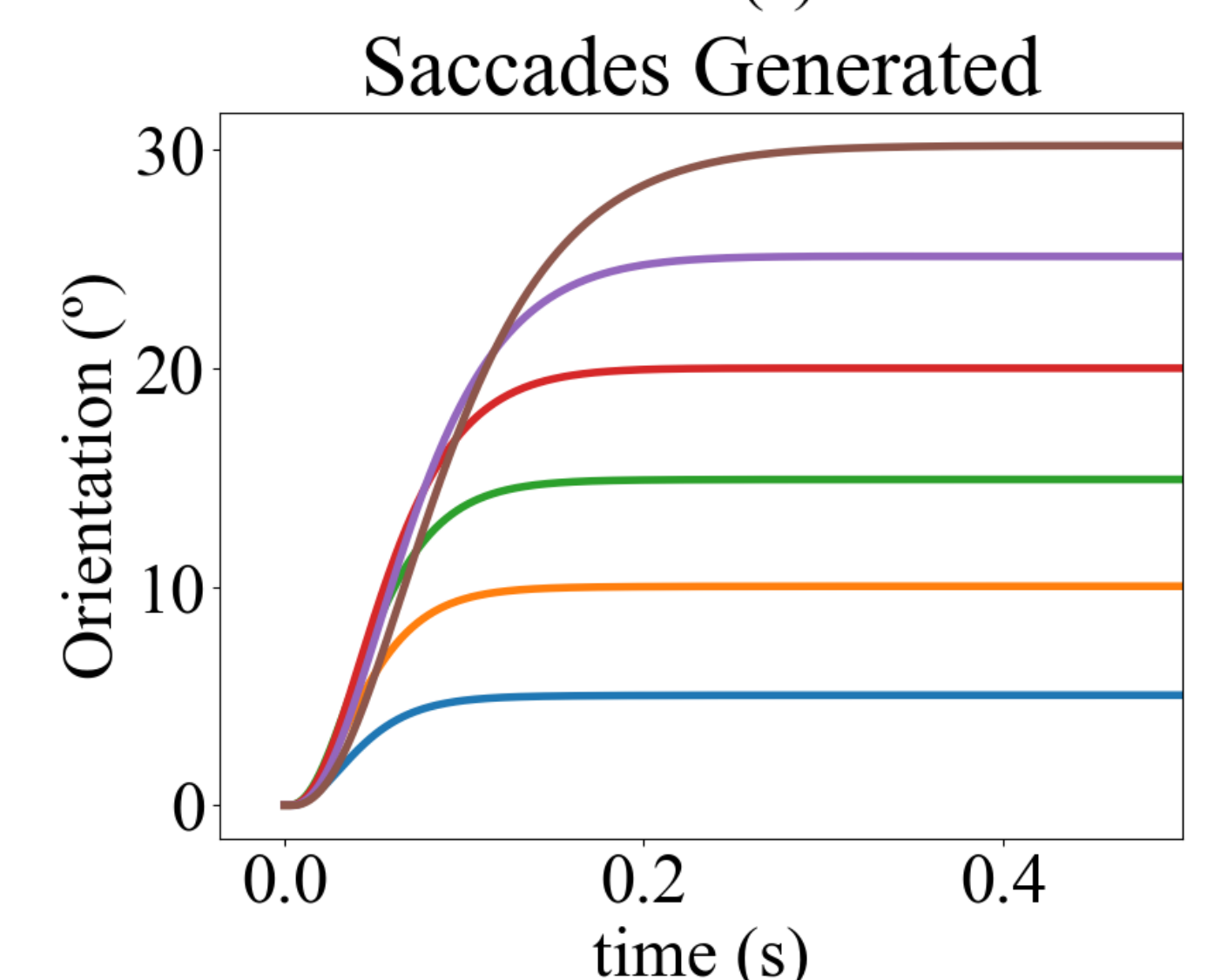
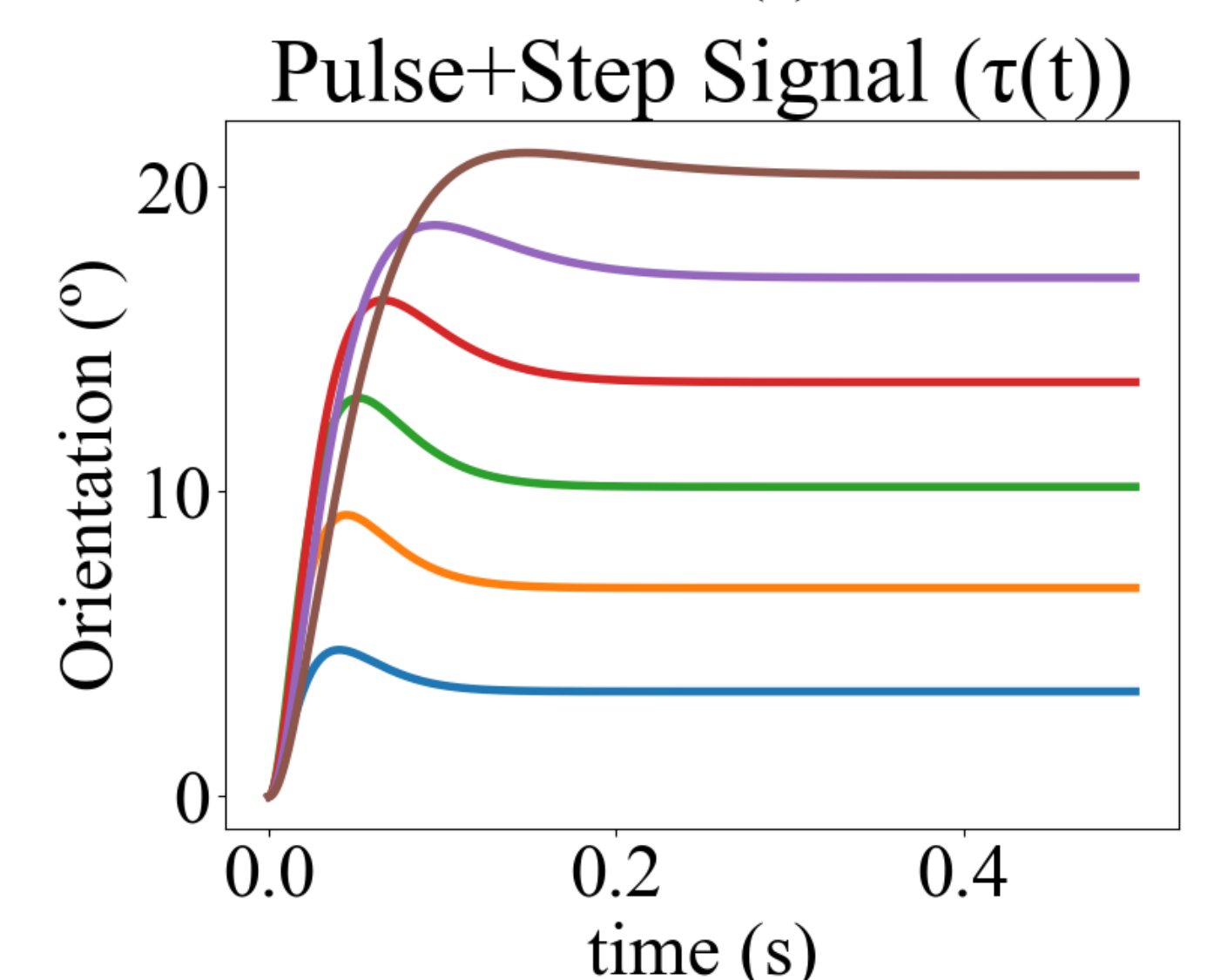
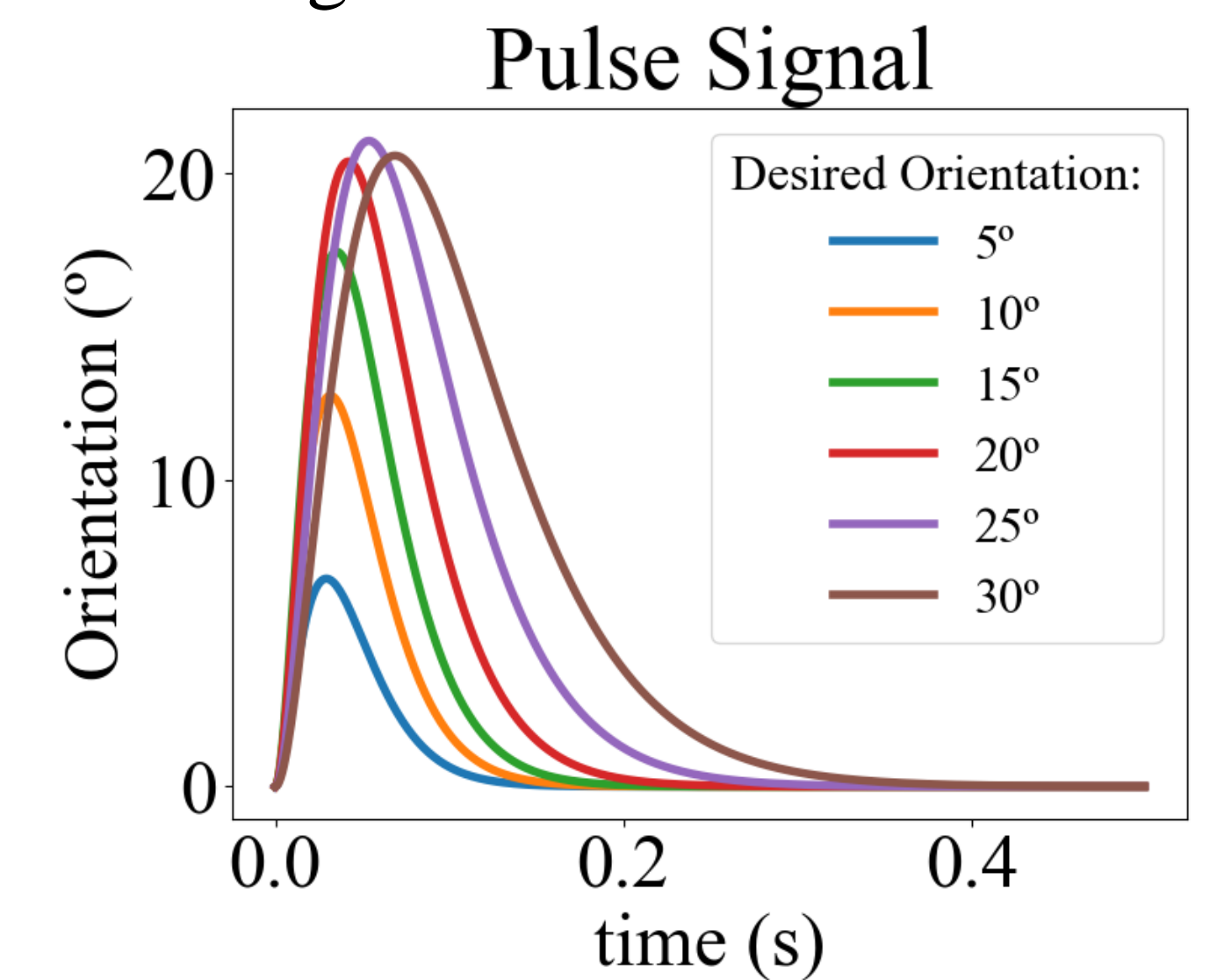
Method

- Model-Free Reinforcement Learning
- Soft-Actor-Critic
- Control inspired on human neurophysiology
- $\tau(t)$ – motor rotation

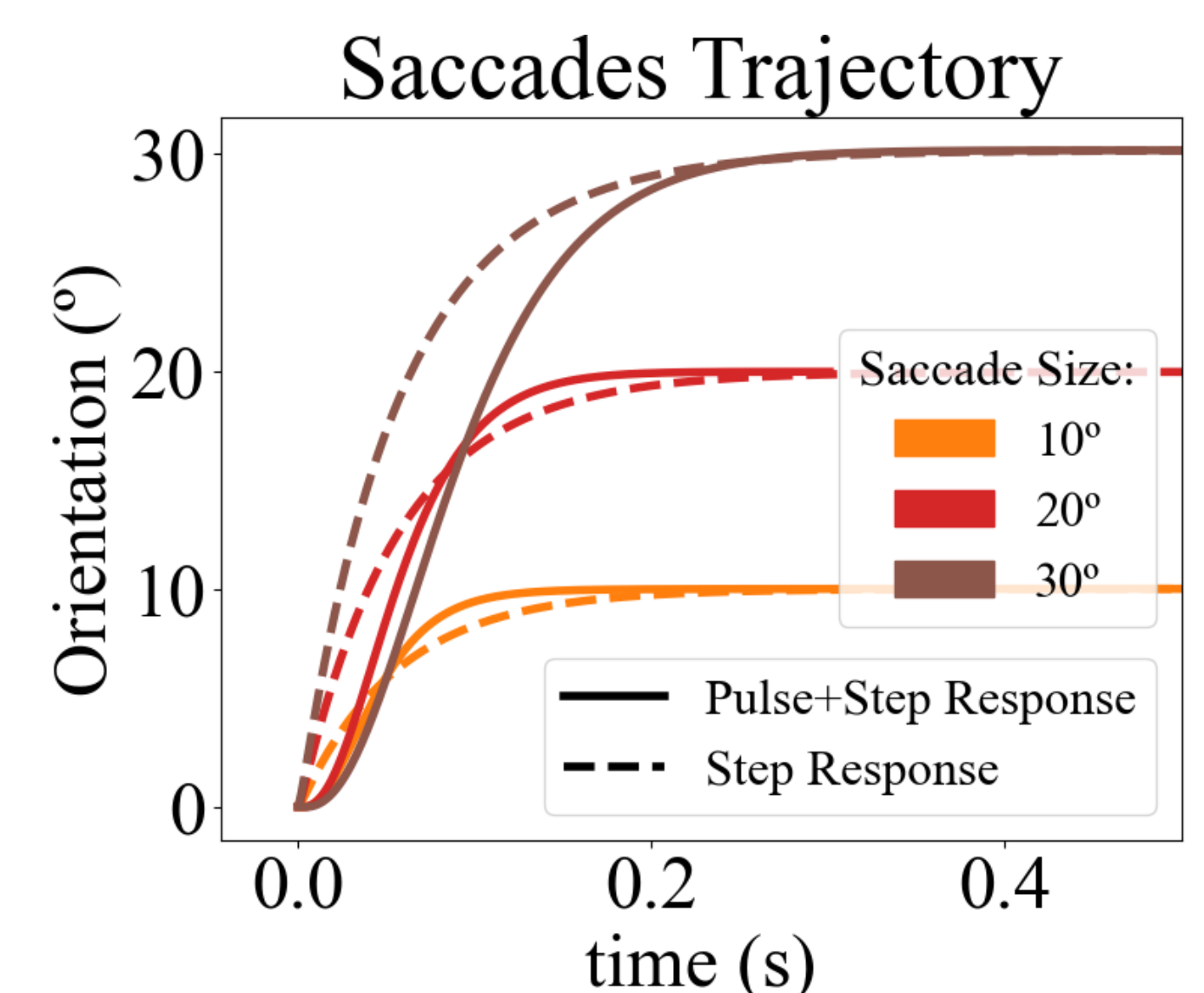


Results

Generated Signals:



Soft-Actor-Critic Response vs. Step Response:



Conclusion

- Successfully learned biomimetic horizontal saccades from -35° to 35°
- It took fewer than 10k iterations to learn reasonable solutions
- Future work:
 - Address full 3D saccades
 - Improve the eye model with 6 independent muscles