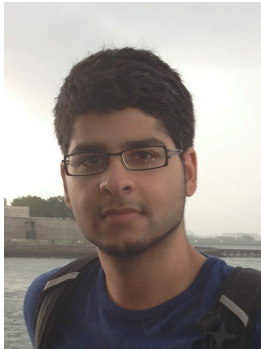# Deep Learning Helicopter Dynamics Models
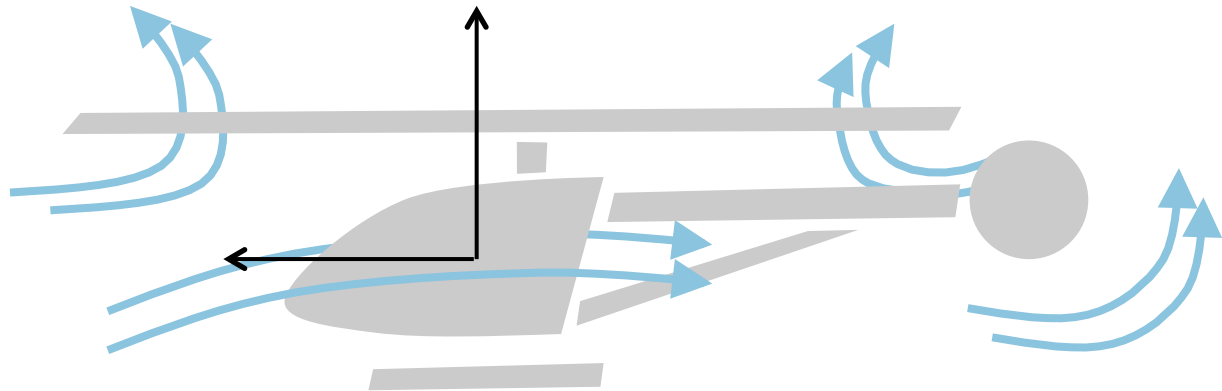

Ali Punjani
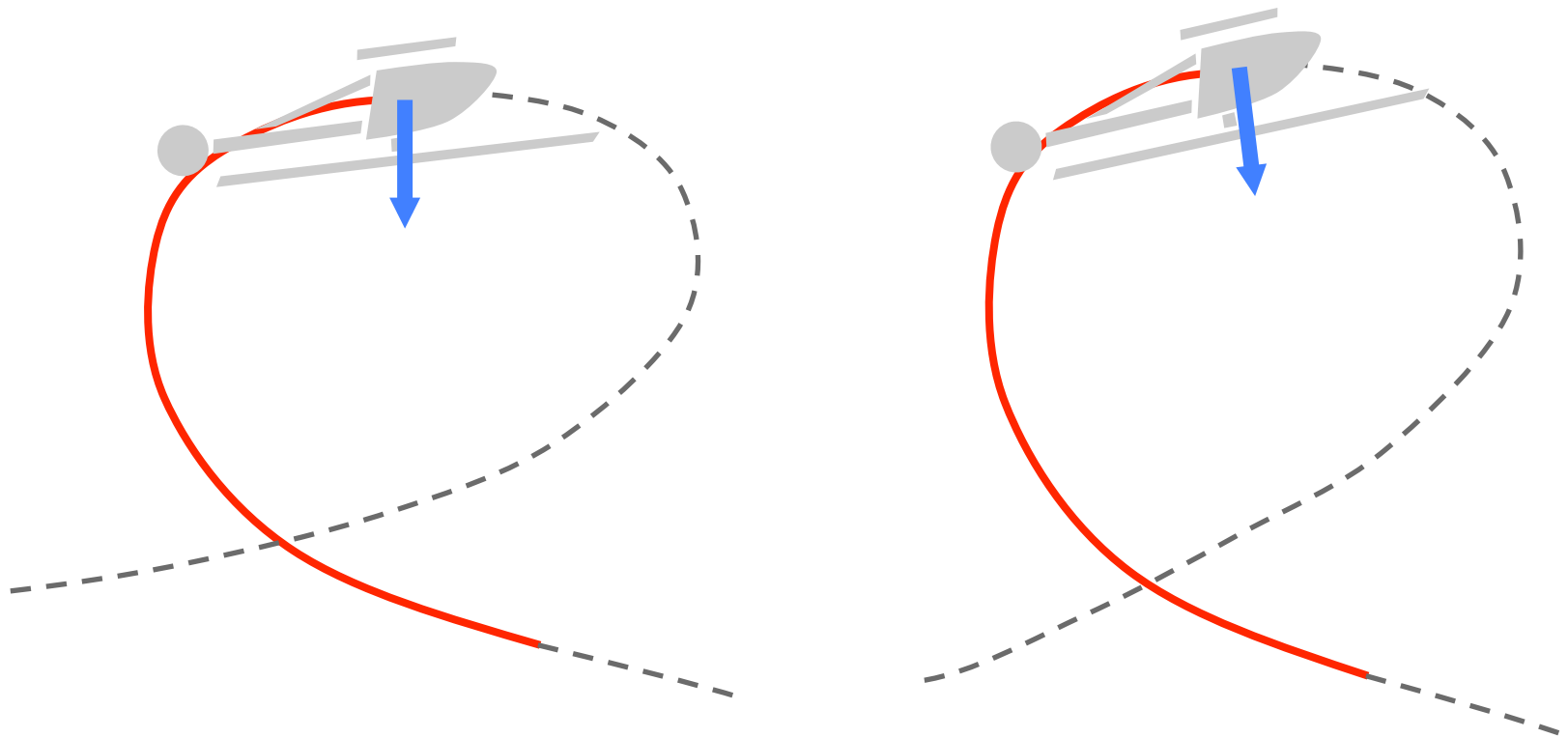

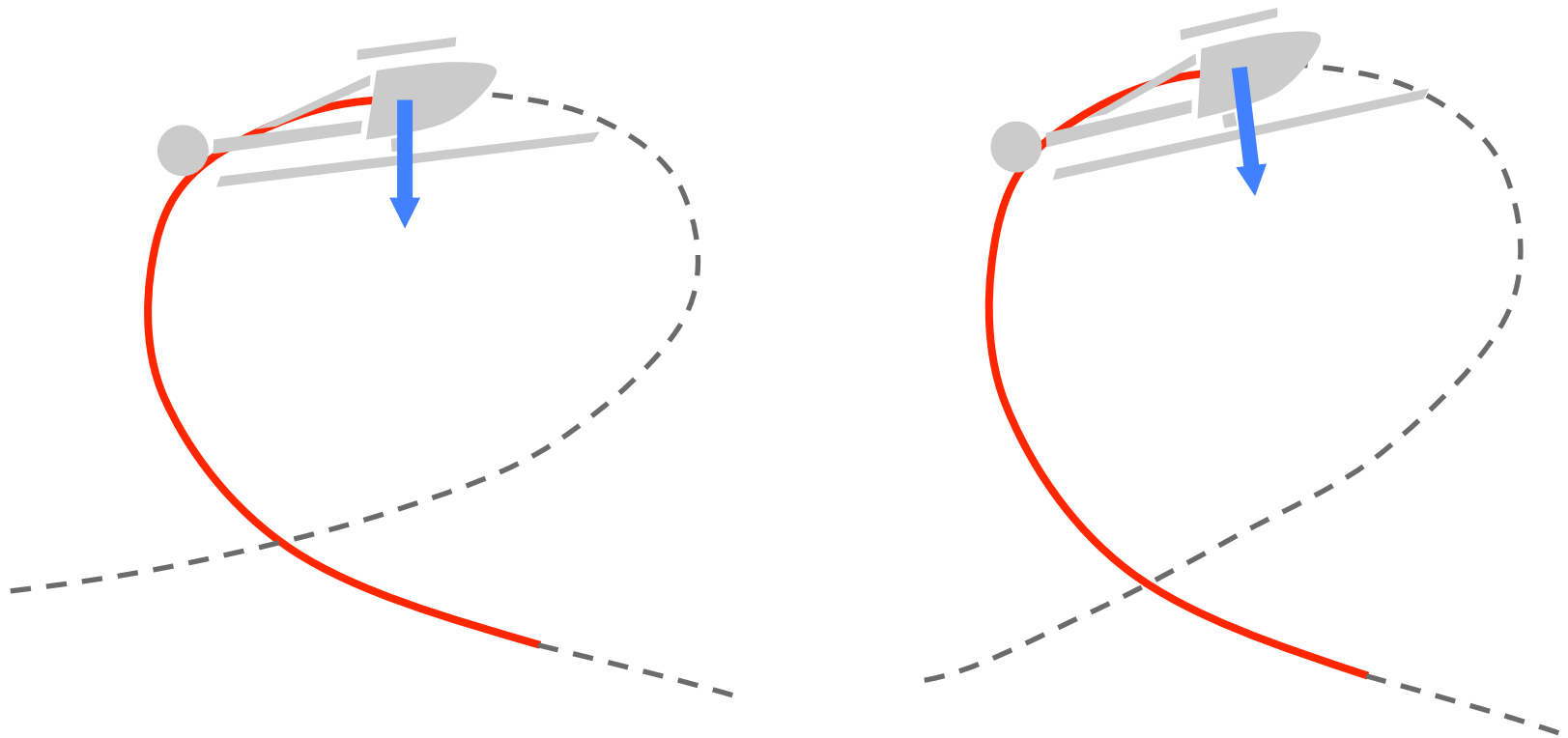Pieter Abbeel

UC Berkeley EECS

Latent State: <u>Airflow</u>, Flexibility, Engine Dynamics etc.
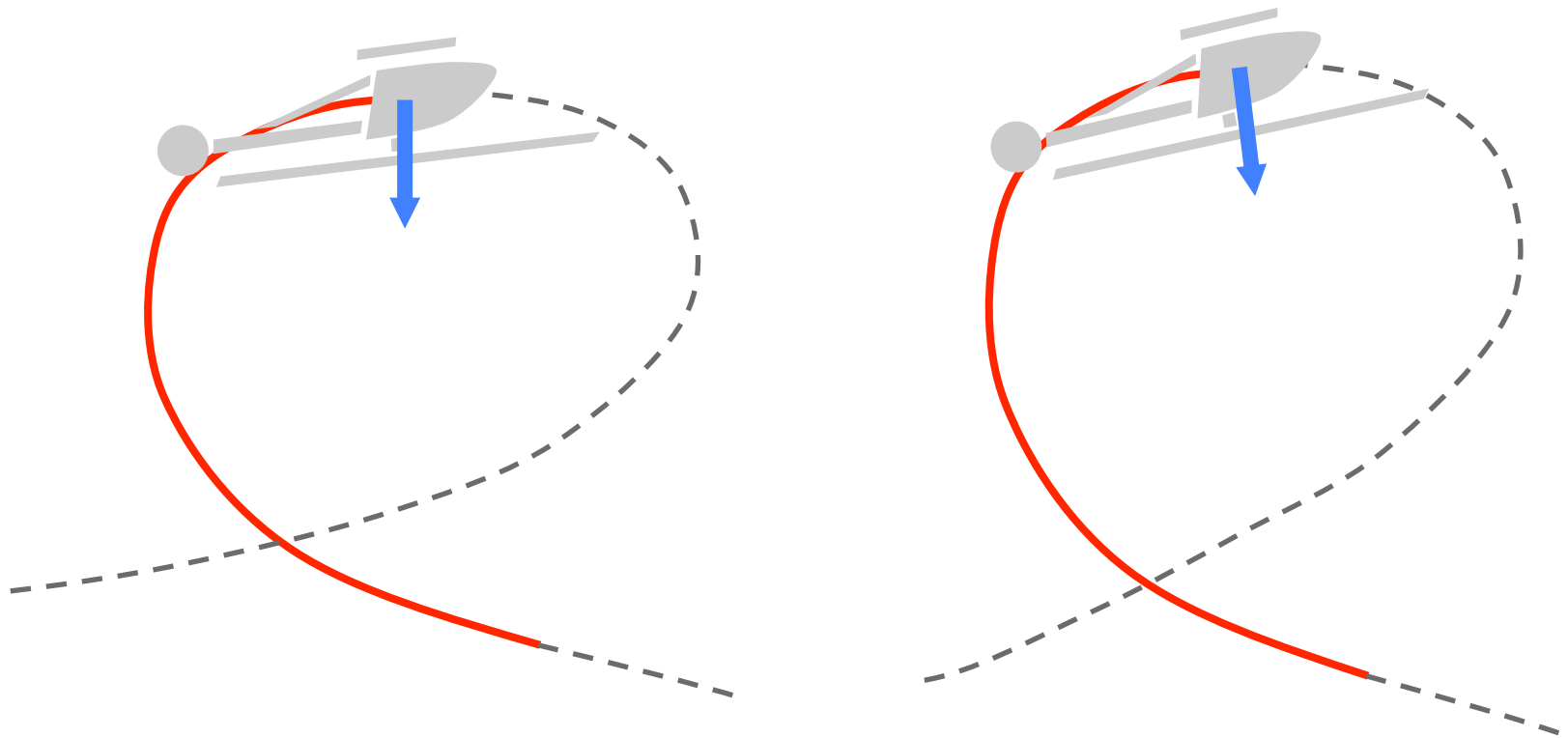
Similar trajectories have similar dynamics

$$\dot{s} = f(\underline{s_t, u_t, s_{t-1}, u_{t-1}, \ldots s_{t-H}, u_{t-H}})$$

acceleration   state-control trajectory
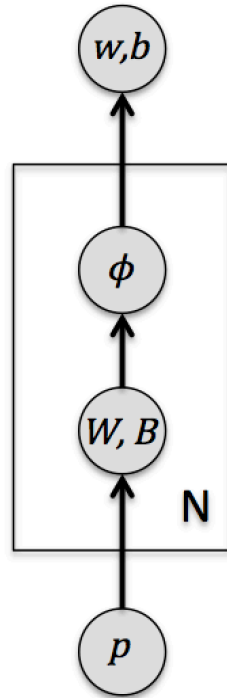
Similar trajectories have similar dynamics

$$\dot{s} = f(s_t, u_t, s_{t-1}, u_{t-1}, ... s_{t-H}, u_{t-H})$$
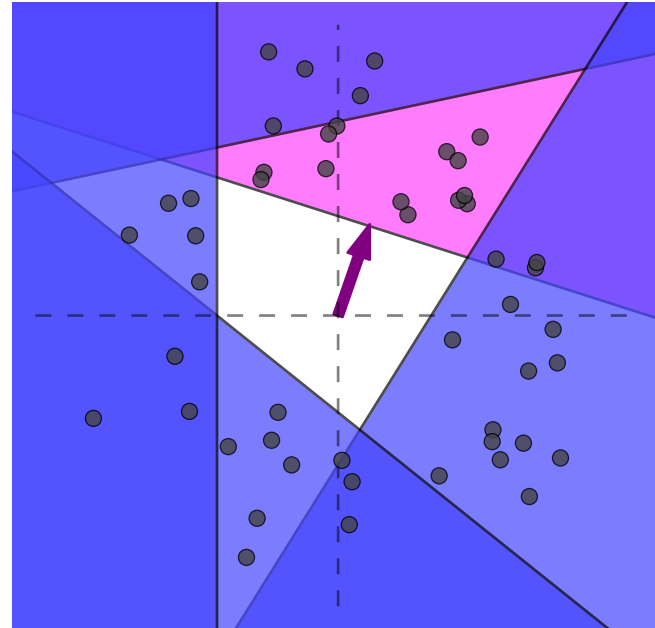
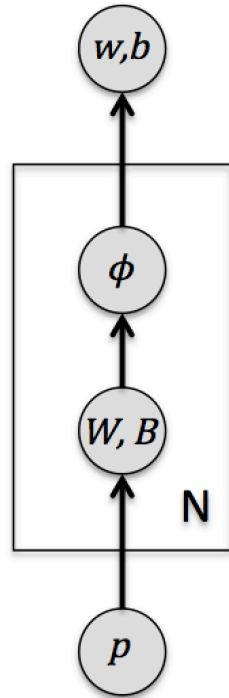acceleration   state-control trajectory

Need similarity and local dynamics
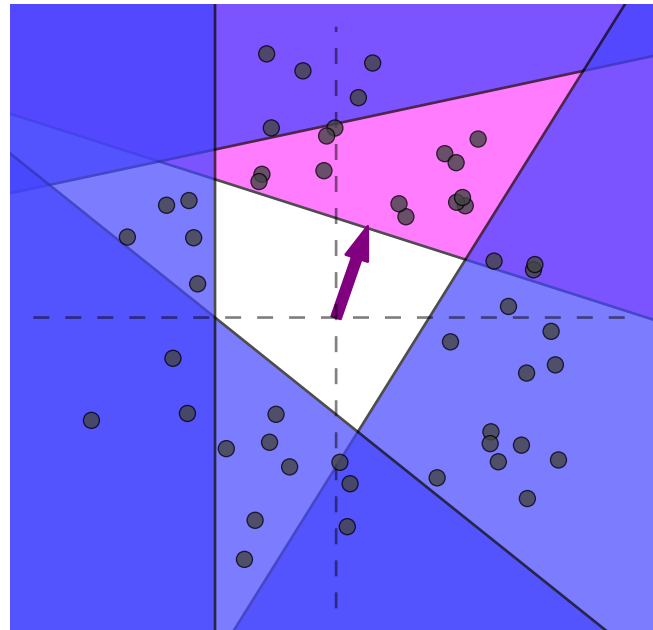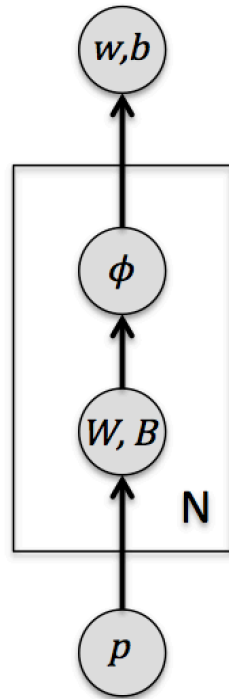
Hierarchical Network Model

Input raw 0.5 second trajectory; Output acceleration
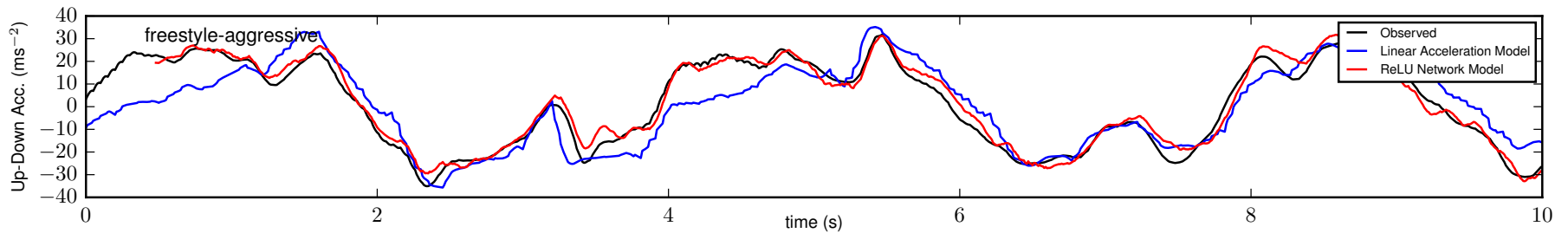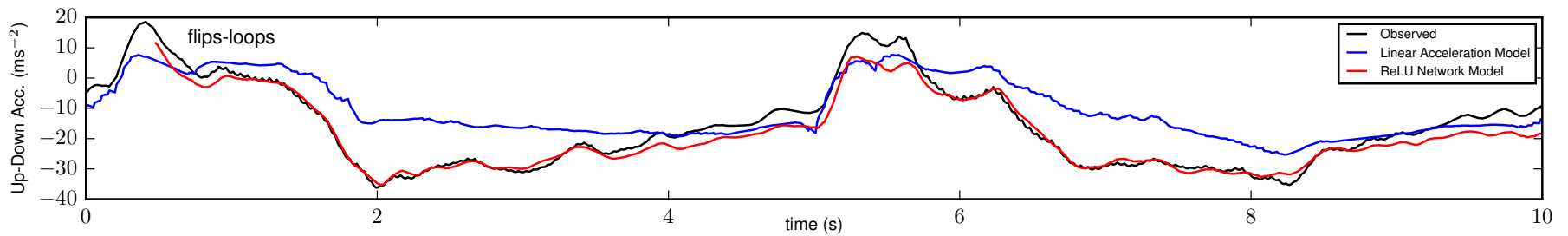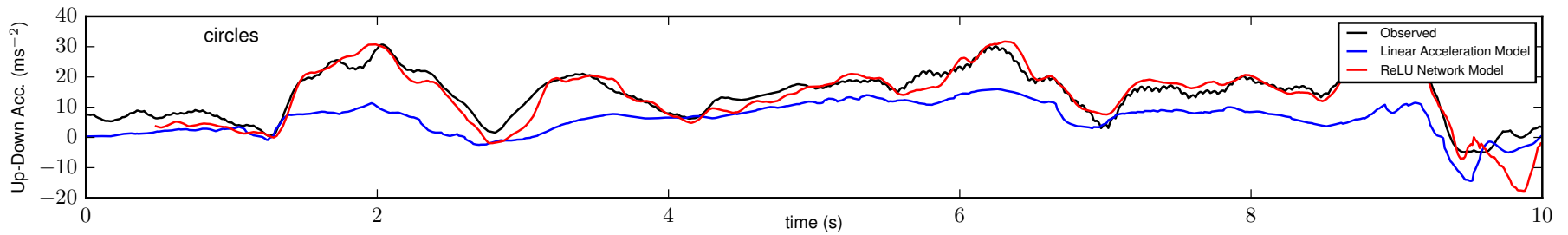
Hierarchical Network Model

Hierarchical Network Model

Jointly learn partitions of input space and local dynamics

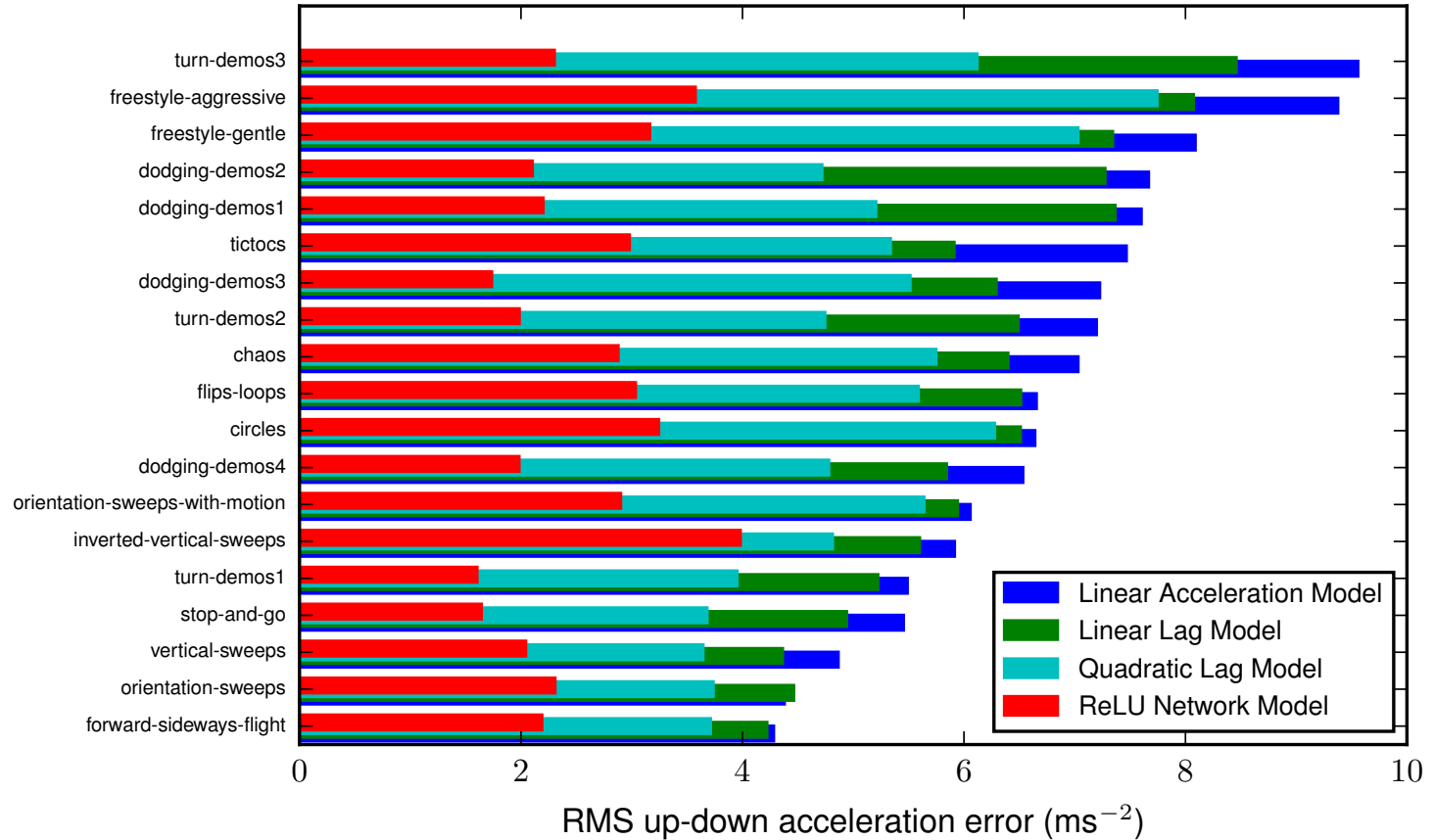No labels or annotation

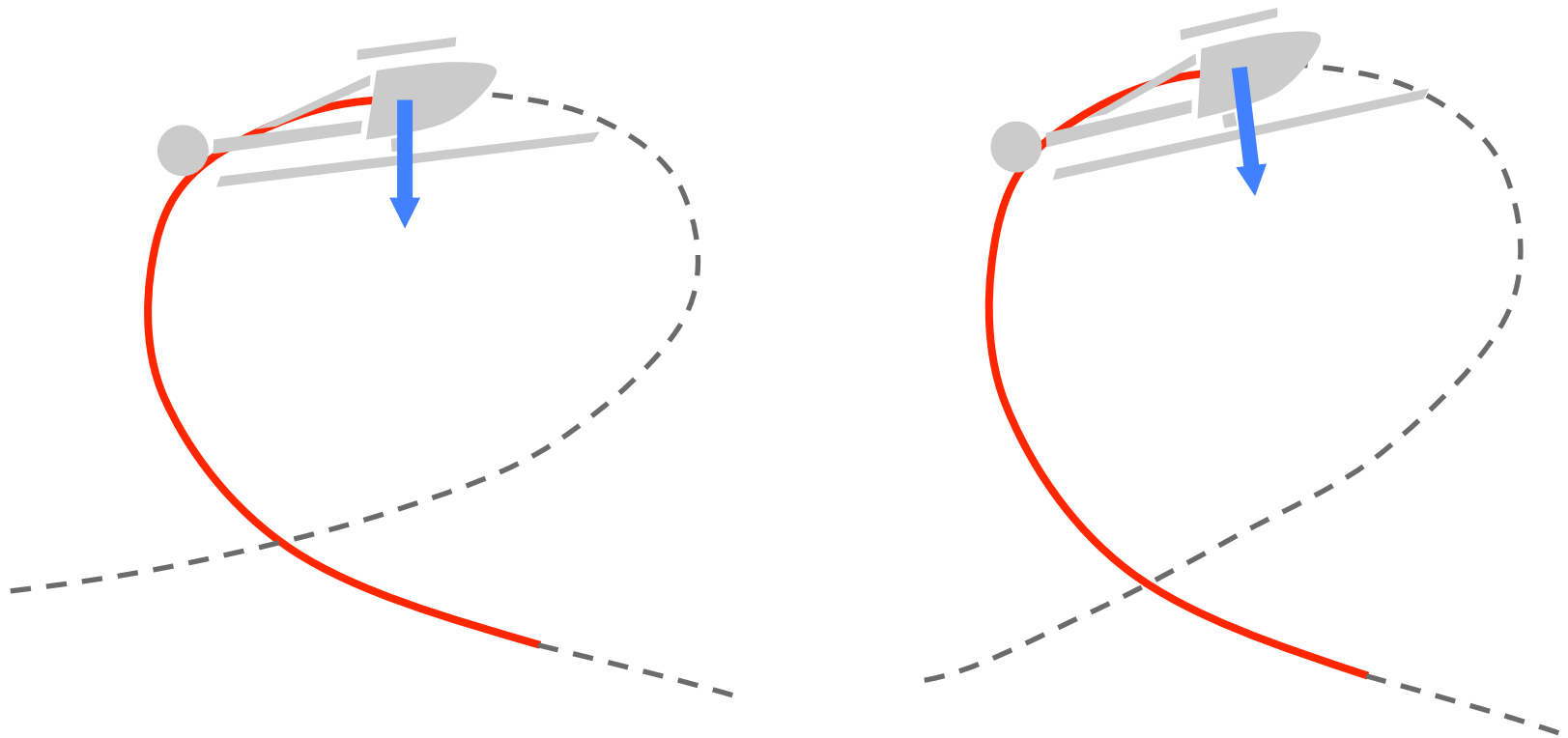Stanford Autonomous Helicopter Data

Results on held-out test set

Up-Down Acceleration Error

60% Improvement across all maneuvers

Thanks!

Apprenticeship Learning (Abbeel, Coates, Ng 2010)

Similar trajectories have similar dynamics