Variable Impedance Learning

Mike and Saif

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1 Point-Mass object pulling a spring (pybullet)

Task: Learn the varying 3D Kp and Kd required to pull a spring to a desired height (with minimum effort)

- 100 time steps (Hence, 100 x (3 + 3) parameters to learn as single policy or 100 separate policies)
- Learner: CREPS
- Policy: Linear Gaussian

Other Info:

- Time steps = 100
- Spring stiffness = 3
- Episodes = 1000
- Kp scale = 0.25*(Kd scale^2)

REPS params:

- Entropy bound = 2.0
- Context dim = 9 (3x pos, 3x delta_pos, 3x force)
- Context feature dim = 9
- 1 policy per time step

Cost function

$$\sum_t \left(X_t^T Q_1 X_t + \dot{X}_t^T Q_2 \dot{X}_t + U_t^T R_1 U_t + \dot{U}_t^T R_2 \dot{U}_t + K_t^T R_3 K_t + \dot{K}_t^T R_4 \dot{K}_t \right)$$
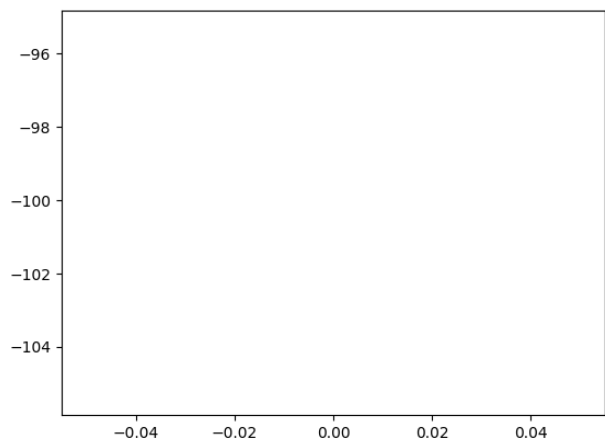
1.1 Table of Hyperparameters

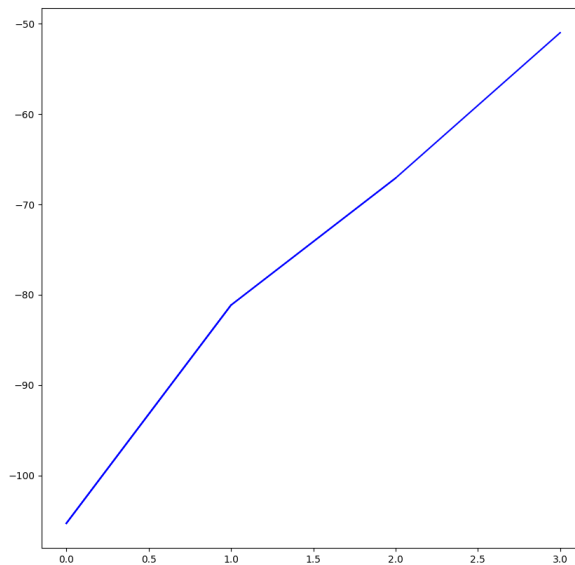|	
Goal pos weight	1.75
Goal vel weight	0.0
Control weight	0.0
Delta Ctrl weight	0.0
Kp-Kd weight	0.25
Delta Kp-Kd weight	0.25
Cumsum reward	False
Sigmoid reward	False
Gamma	1.0
Next force prediction	True
Time step	0.5
Kd Scale	2.0
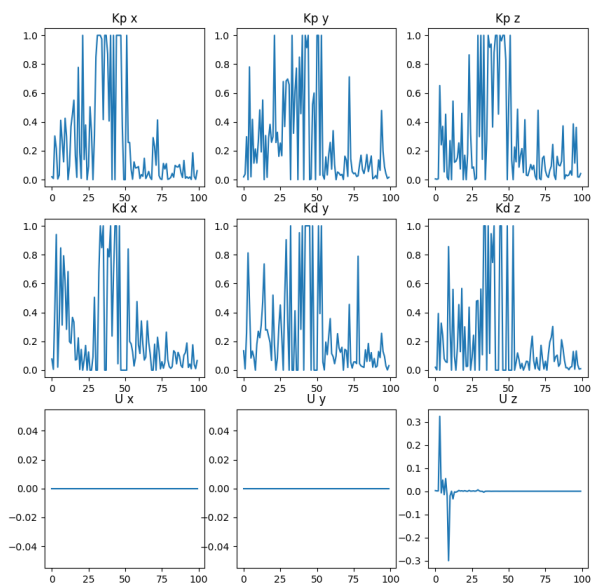
(a) Param values
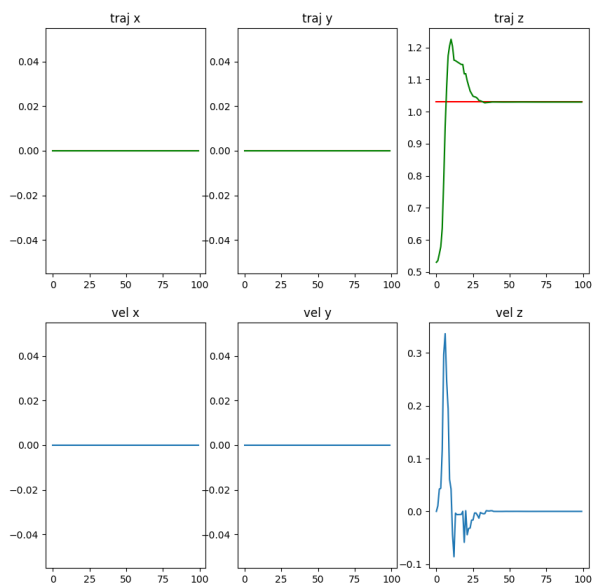
(b) Trajectory and Velocity

(a) Mean reward

(b) Reward splits