

Crazy Dog Report

Github: https://github.com/alexlee511/crazydog_robot.git

```
A_c = np.array([
    [0.0, 1.0,      0.0,      0.0],
    [0.0, 0.0, (m * g) / M,      0.0],
    [0.0, 0.0,      0.0,      1.0],
    [0.0, 0.0, g * (M + m) / (l * M), 0.0]
])
```

```
B_c = np.array([
    [0.0],
    [1.0 / M],
    [0.0],
    [1.0 / (l * M)]
])
```

LQR weighting matrices (can be tuned further)

```
Q = np.diag([0.5, 0.1, 150.0, 20.0]) # x, x_dot, theta, theta_dot
```

```
R = np.array([[0.5]])
```

$g = 9.8$

$M_{w_single} = 0.28$ # Mass of a single wheel [kg]

$m_{body} = 7.08$ # Body mass [kg]

$l = 0.37$ # Distance from wheel axle to body COM [m]

$r = 0.07$ # Wheel radius [m]

Equivalent "base mass" (two wheels + rotational inertia equivalent)

$2*M + 2*(1/2*M) = 3M \approx 0.84$ kg

$M_{base} = 3.0 * M_{w_single}$

$M = M_{base}$ # Cart mass

$m = m_{body}$ # Pendulum mass

Euler discretization

$A = \text{np.eye}(4) + dt * A_c$

$B = dt * B_c$

$K, P, \text{eigVals} = \text{dlqr}(A, B, Q, R)$

