## Computed torque control (one method to control a robot)

Consider a typical model for a robot manipulator.

$$\underbrace{M(q)}_{\text{inertia matrix}}\ddot{q} + \underbrace{C(q,\dot{q})}_{\text{Coriolis and centrifugal terms}} + \underbrace{g(q)}_{\text{gravity terms}} = \tau$$

torque applied

e.g. simple pendulum

$$\frac{ml^2\ddot{\theta}}{3} + \frac{mgl\cos\theta}{2} = \tau$$

$q=\theta \quad M(q)=\frac{ml^2}{3} \quad C(q,\dot{q})=0 \quad g(q)=\frac{mgl\cos\theta}{2}$

To do computed torque control:

given the current position $q$, velocity $\dot{q}$, and desired acceleration $\ddot{q}_d$, compute the torque that will produce $\ddot{q}_d$

If we have a regression model we can compute the torque

$$\tau = w^T \phi(q, \dot{q}, \ddot{q})$$

You probably need feedback to make it work in real life.

$$\tau = w^T \phi(q, \dot{q}, \ddot{q}) + \underbrace{K_p}_{\text{proportional gain}} (q_d - \underbrace{q}_{\text{measure}}) + \underbrace{K_d}_{\text{derivative gain}} (\dot{q}_d - \underbrace{\dot{q}}_{\text{measure}})$$