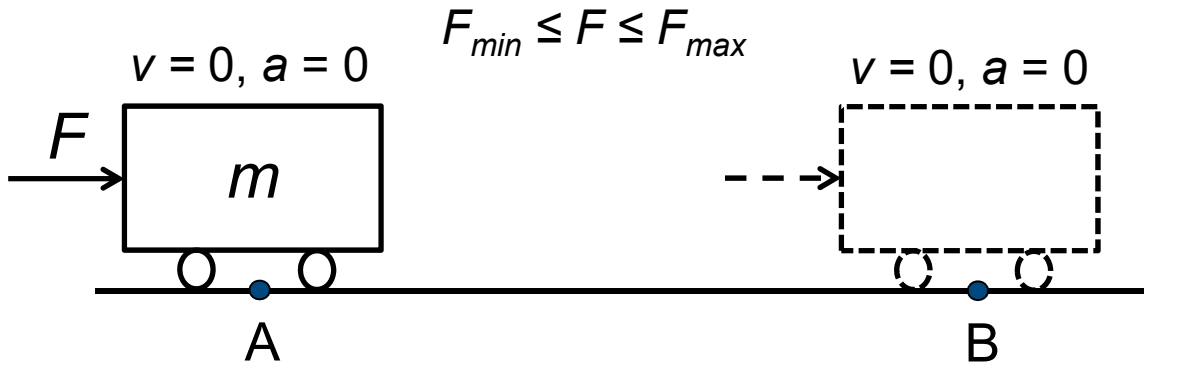
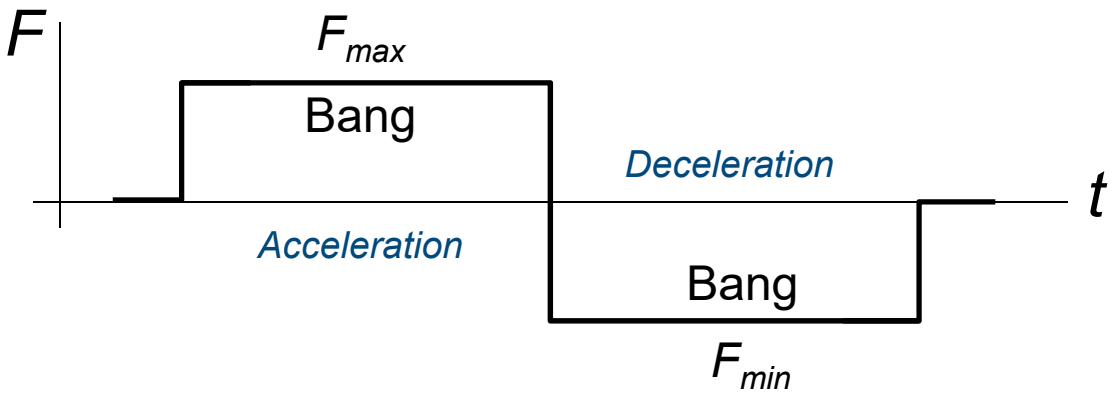
Track Seeking

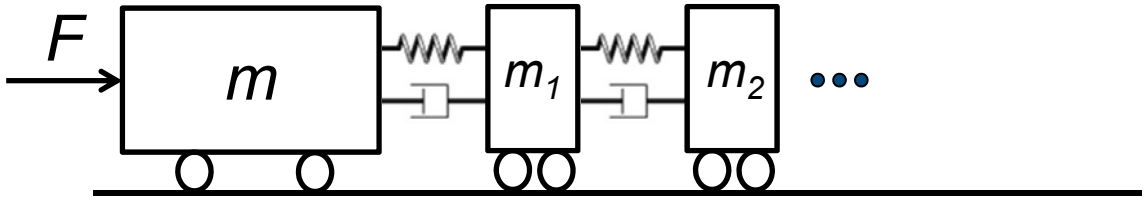
- Fundamental Question: How can we move mass *m* from point A to point B in minimum time?

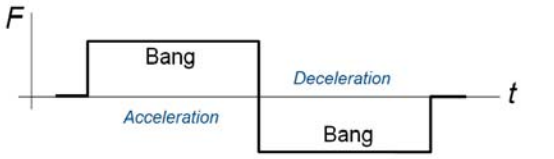


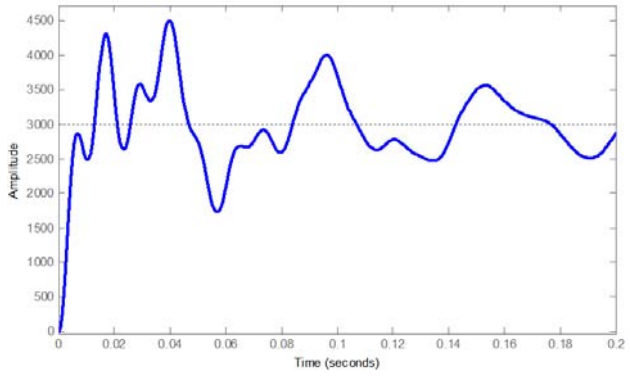


Track Seeking

- What if the system is not fully rigid?







Bang-Bang control moves the mass to the target very quickly, but it also excites system modes and creates undesirable vibrations upon arrival

So, we need to apply the force smoothly!

Track Seeking

- A practical approach is to create a polynomial trajectory for the force and apply smoothness conditions at the arrival point:

$$F(t) = ma(t) = m\{a_0 + a_1 t + a_2 t^2 + a_3 t^3 + a_4 t^4\}$$

$$v(t) = v_0 + a_0 t + \frac{1}{2} a_1 t^2 + \frac{1}{3} a_2 t^3 + \frac{1}{4} a_3 t^4 + \frac{1}{5} a_4 t^5$$

$$p(t) = p_0 + v_0 t + \frac{1}{2} a_0 t^2 + \frac{1}{6} a_1 t^3 + \frac{1}{12} a_2 t^4 + \frac{1}{20} a_3 t^5 + \frac{1}{30} a_4 t^6$$

Initial conditions @ $t = 0$:

$$p(0) = p_0$$
$$v(0) = 0$$
$$a(0) = 0$$

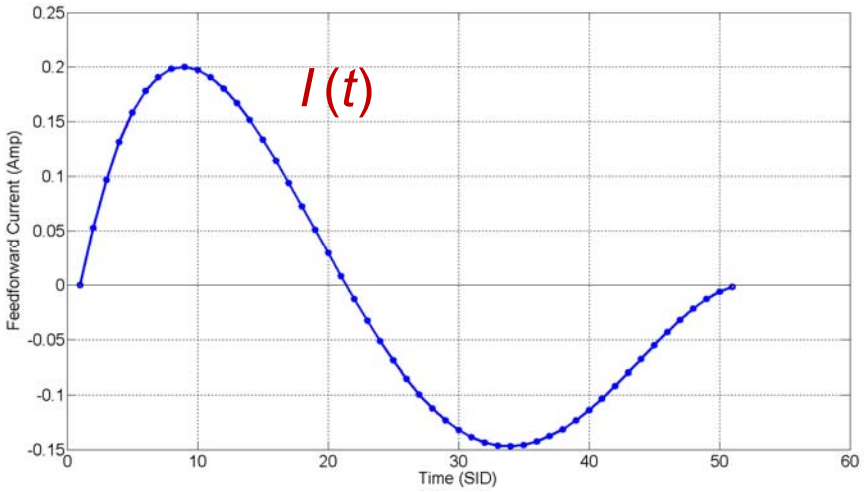
Final conditions @ $t = T$:

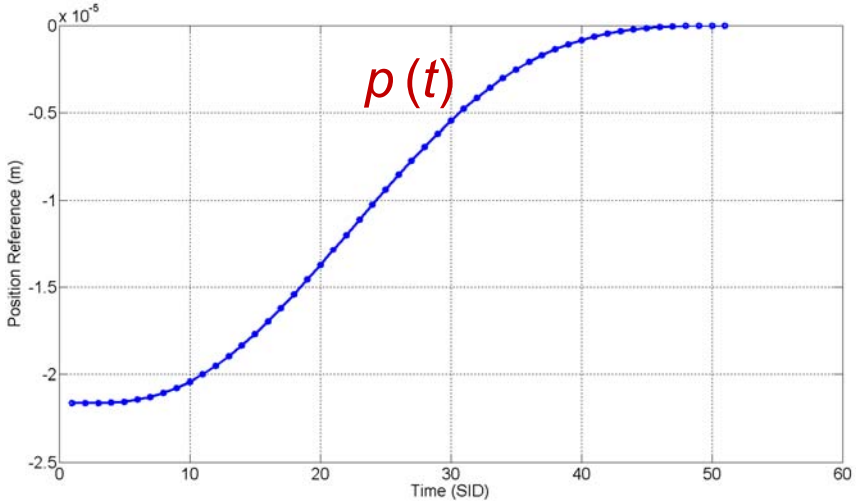
$$p(T) = p_T$$
$$v(T) = 0$$
$$a(T) = 0$$
$$Jerk(T) = 0$$

7 Equations, 7 Unknowns → We can solve for $\{p_0, v_0, a_0, a_1, a_2, a_3, a_4\}$

Track Seeking

- Example of polynomial trajectories:





Track Seeking (Implementation)