

$$f(t) - b v(t) = M \frac{dv(t)}{dt}$$

$$\frac{dv(t)}{dt} = -\frac{b}{m} v(t) + \frac{1}{m} f(t)$$

$$\frac{v(t+\Delta t) - v(t)}{\Delta t} = -\frac{b}{m} v(t) + \frac{1}{m} f(t)$$

$$v(t+\Delta t) = v(t) - \frac{b \Delta t}{m} v(t) + \frac{\Delta t}{m} f(t)$$

t^*

$$v(t^* + \Delta t) = v(t^*) - \frac{b}{m} \Delta t v(t^*) + \frac{\Delta t}{m} \underbrace{f(t^*)}_{\text{circled}}$$

$$\frac{dp(t)}{dt} = v$$

$$\frac{p(t+\Delta t) - p(t)}{\Delta t} = v(t)$$

$$\boxed{p(t+\Delta t) = p(t) + \Delta t v(t)}$$

$$\dot{\theta} = \omega$$

$$\frac{\theta(t+\Delta t) - \theta(t)}{\Delta t} = \omega(t)$$

$$\theta(t+\Delta t) = \theta(t) + \omega(t)\Delta t$$

$$\dot{\omega} = -g\theta - \frac{b}{J}\omega + \frac{1}{J}f$$

$$\frac{\omega(t+\Delta t) - \omega(t)}{\Delta t} = -g\theta(t) - \frac{b}{J}\omega(t) + \frac{1}{J}f(t)$$

$$\omega(t+\Delta t) = \omega(t) - \underbrace{g\Delta t\theta(t)}_{\theta(t+\Delta t)} - \frac{b\Delta t}{J}\omega(t) + \frac{\Delta t}{J}f(t)$$

