

### Non-Linear Disturbance Observer

$$\dot{z}_p = -L_p z_p - L_p [L_p \dot{p} + G + \frac{1}{m} U_p]$$

$$\hat{d}_p = z_p + L_p \dot{p}$$

$$\dot{z}_\Theta = -L_\Theta z_\Theta - L_\Theta [L_\Theta \dot{\Theta} + \Phi(\Theta, \dot{\Theta}) - U_\Theta]$$

$$\hat{d}_\Theta = z_\Theta + L_\Theta \dot{\Theta}$$

### Super-Twisting Observer

$$\dot{z}_p = -L_p z_p - L_p [L_p \dot{p} + G + \frac{1}{m} U_p]$$

$$\hat{d}_p = z_p + L_p \dot{p}$$

$$\dot{z}_\Theta = -L_\Theta z_\Theta - L_\Theta [L_\Theta \dot{\Theta} + \Phi(\Theta, \dot{\Theta}) - U_\Theta]$$

$$\hat{d}_\Theta = z_\Theta + L_\Theta \dot{\Theta}$$