Force Estimation of Pressing Robot

The structure of SPO

$$\tilde{x}_1 = \hat{x}_1 - \theta_m, \quad (\theta_m = \text{motor angle})$$

Sliding Observer (SO)

$$\dot{\hat{x}}_1 = \hat{x}_2 - k_1 sat(\tilde{x}_1) - \alpha_1 \tilde{x}_1$$

$$\dot{\hat{x}}_2 = \alpha_3 \tau_m - k_2 sat(\tilde{x}_1) - \alpha_2 \tilde{x}_1 + \hat{\Psi}$$

$$\dot{\hat{x}}_3 = \alpha_3^2 (-\hat{x}_3 + \alpha_3 \hat{x}_2 + \tau_m)$$

$$\hat{\Psi} = \alpha_3 (-\hat{x}_3 + \alpha_3 \hat{x}_2)$$

The method of the force estimation

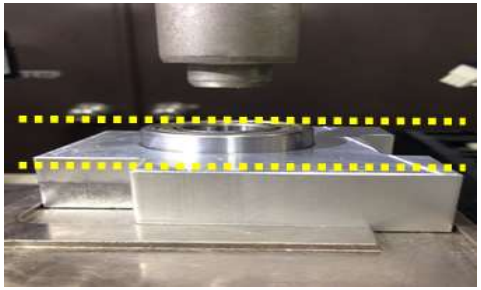
$$\Psi = \Delta + \tau_p$$

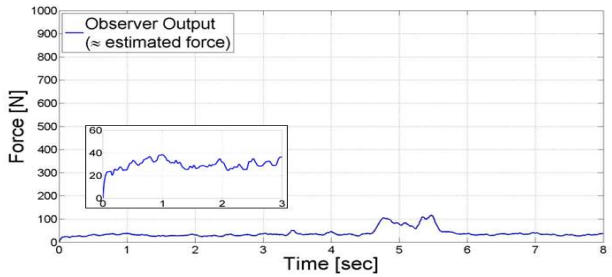
$$\approx \alpha_3 (-\hat{x}_3 + \alpha_3 \hat{x}_2)$$

$$\approx \hat{F} \ (\text{Estimated Force})$$

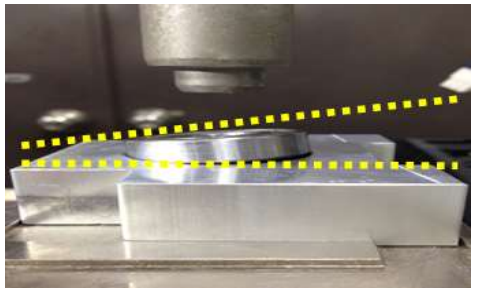
If Δ is small enough,

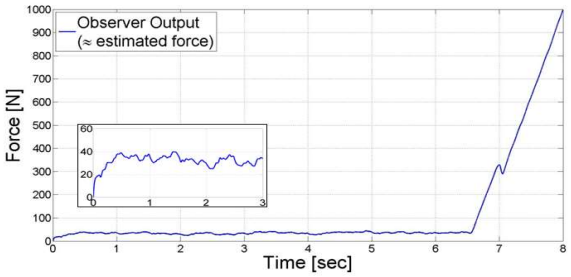
$\hat{\Psi}$ is close to the external force τ_p





The bearing is in a good position





The bearing is in a bad position