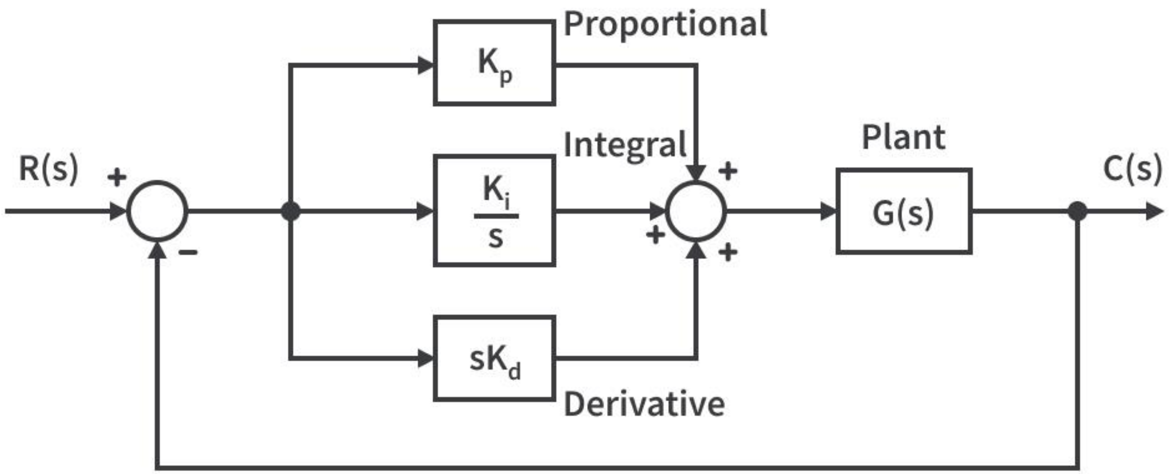
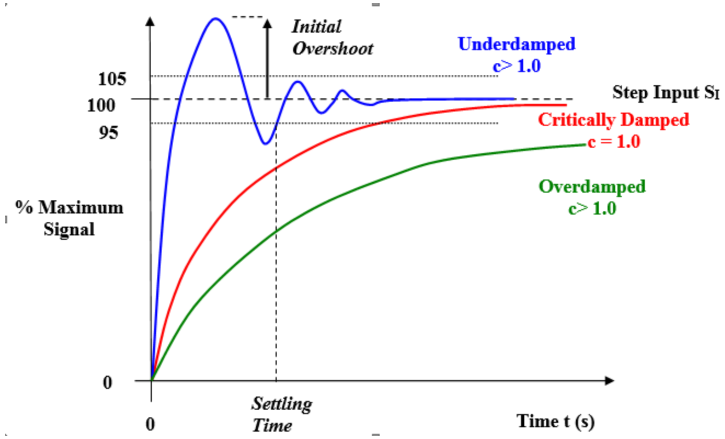
NURA 전국항공우주과학경진대회

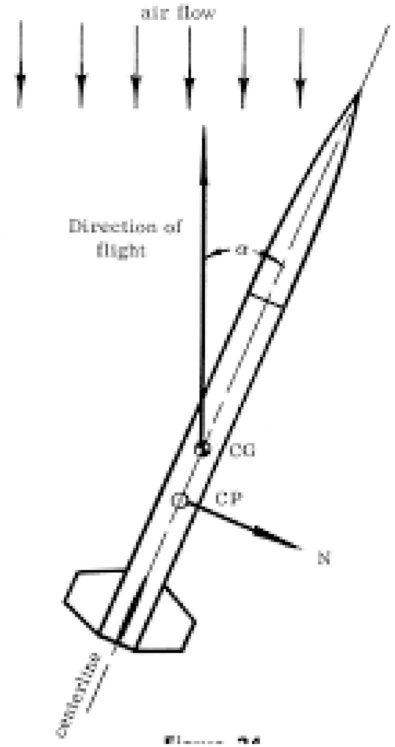
NURA National Aerospace Science Competition

INDEX

Intro







Goal

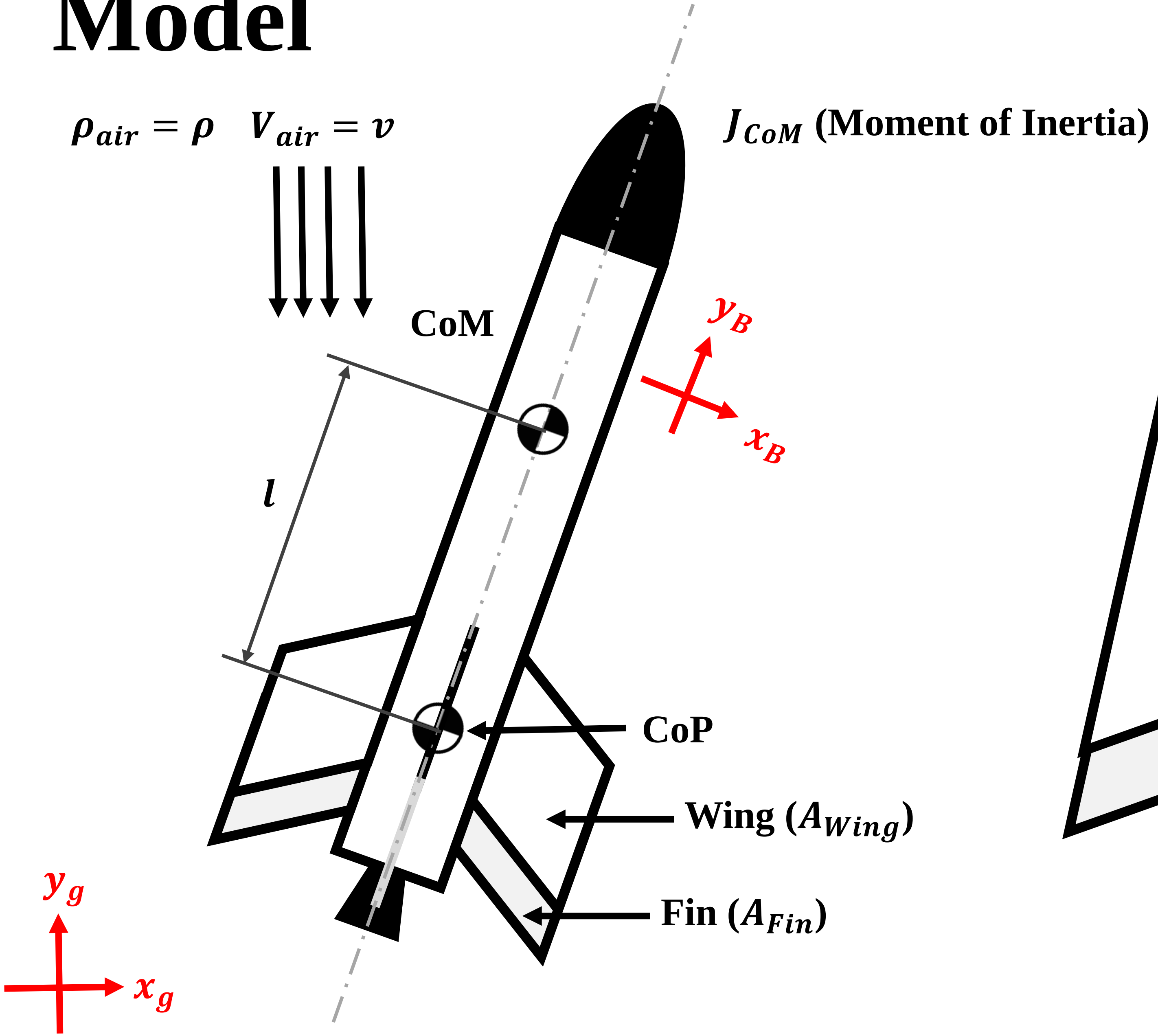
Let's find the best gain with model analysis (vibration analysis)!

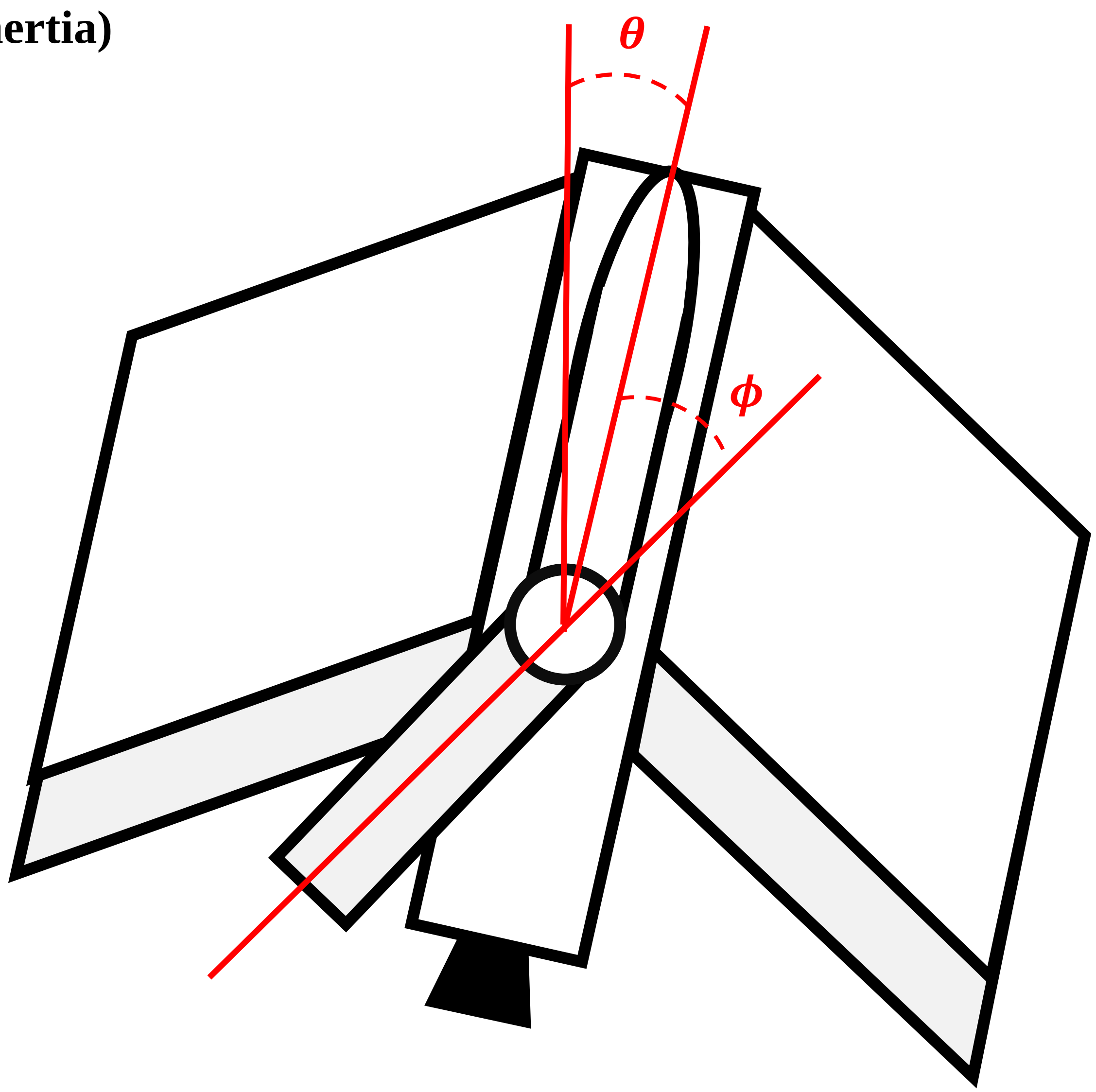
Progress

Moment wheel cord, pin control code complete

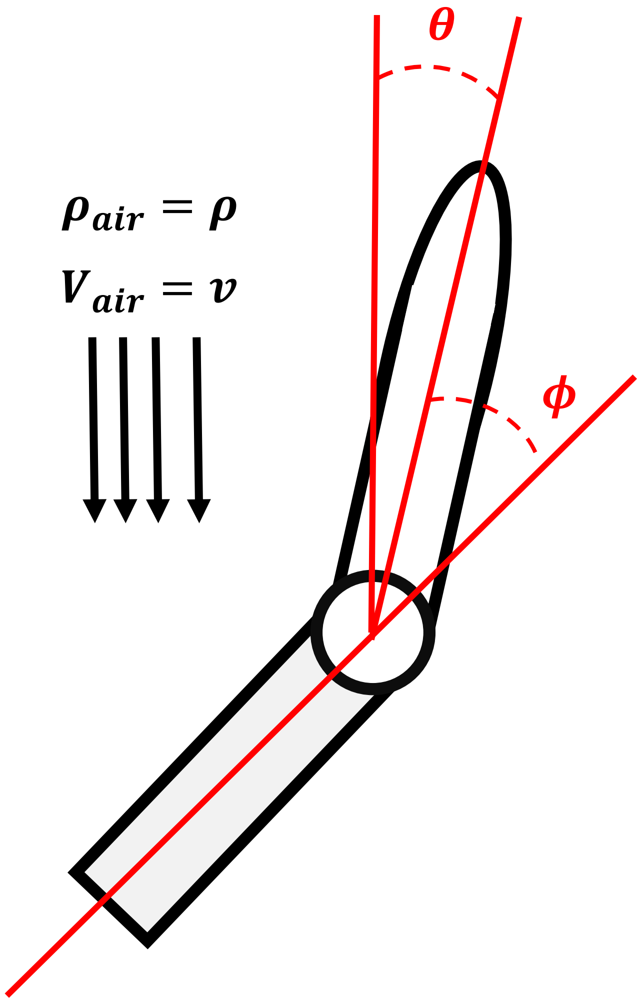
Preparing for the experiment

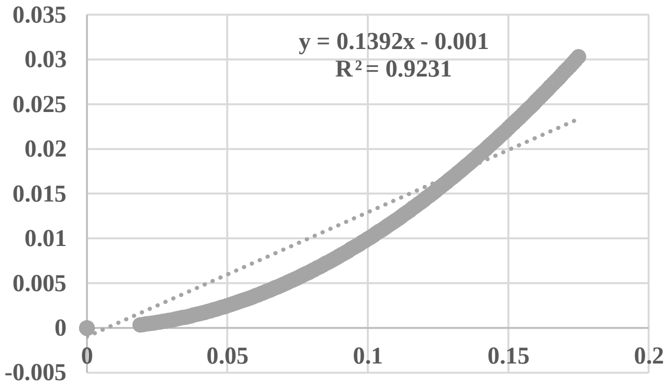
Model


$\rho_{air} = \rho$
$V_{air} = v$
J_{CoM} (Moment of Inertia)
CoM
l
y_B
x_B
CoP
Wing (A_{Wing})
Fin (A_{Fin})
y_g
x_g


θ
ϕ

Model





$$\dot{m}_{Wing} = \rho v A_{\llcorner} sin\theta = \rho v A_{Wing} sin\theta$$

$$\Delta p_{Wing} = \dot{m}_{Wing} v sin\theta = 2\rho A_{Wing} v^2 sin^2\theta \approx 2\rho A_{Wing} v^2 [a\theta]$$

$$\Delta p_{Wing} = F\Delta t = \frac{F}{f}$$

$$\therefore F = 2a\rho A_{Wing} f v^2 \theta$$

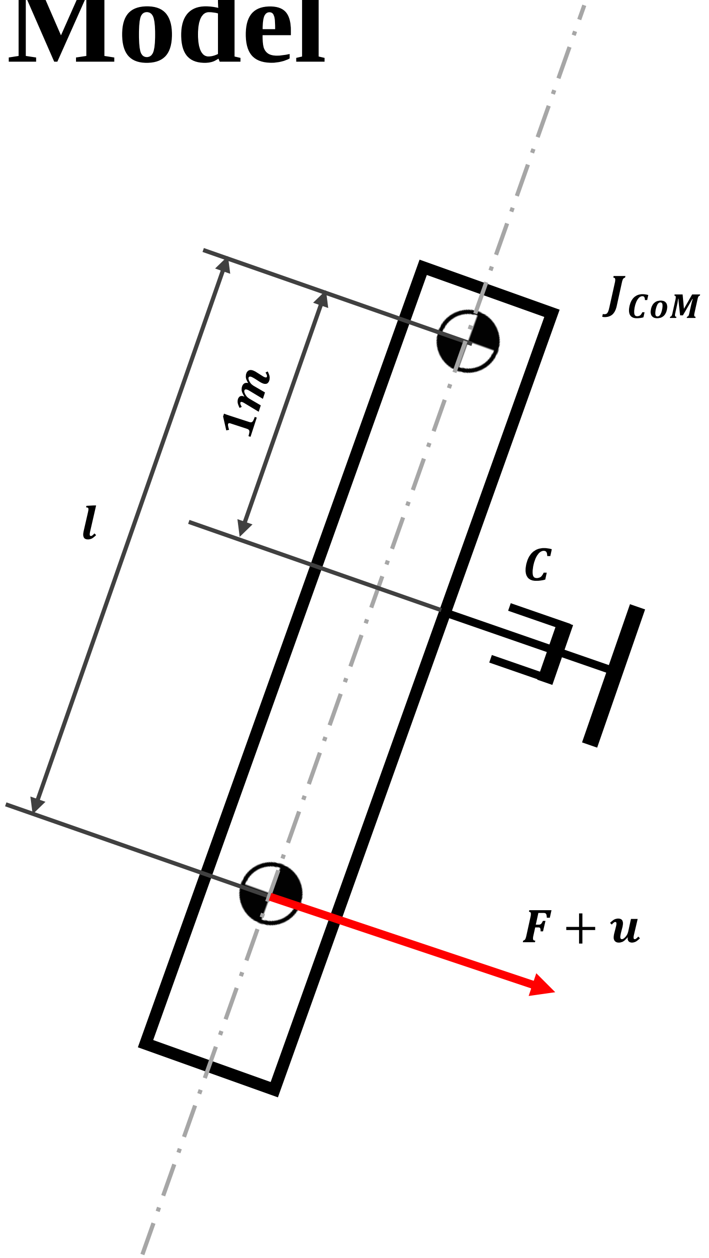
$$\dot{m}_{Fin} = \rho v A_{\llcorner} sin\theta = \rho v A_{Fin} sin(\theta + \emptyset)$$

$$\Delta p_{Fin} = 2\dot{m}_{Fin} v sin(\theta + \emptyset) = 2\rho v^2 A_{Fin} sin^2(\theta + \emptyset) \approx 2\rho A_{Fin} v^2 [b(\theta + \emptyset)]$$

$$\Delta p_{Wing} = u\Delta t = \frac{u}{f}$$

$$\therefore u = 2b\rho A_{Fin} f v^2 (\theta + \emptyset)$$

Model



E.O.M

$$J\ddot{\theta} = -c\dot{\theta} - (F + u)l$$

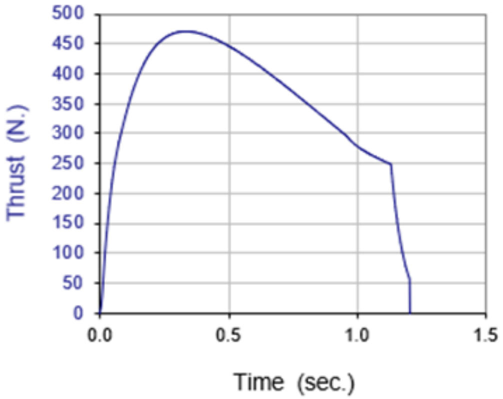
$$J\ddot{\theta} = -c\dot{\theta} - \{(2a\rho A_{Wing} f v^2 \theta) + (2b\rho A_{Fin} f v^2(\theta + \emptyset))\}l$$

$$\because \; F = 2a\rho A_{Wing} f v^2 \theta \,, u = 2b\rho A_{Fin} f v^2(\theta + \emptyset)$$

Laplace

$$\mathcal{L}\{J\ddot{\theta}\} = \mathcal{L}[-c\dot{\theta} - \{(2a\rho A_{Wing} f v^2 \theta) + (2b\rho A_{Fin} f v^2(\theta + \emptyset))\}l]$$

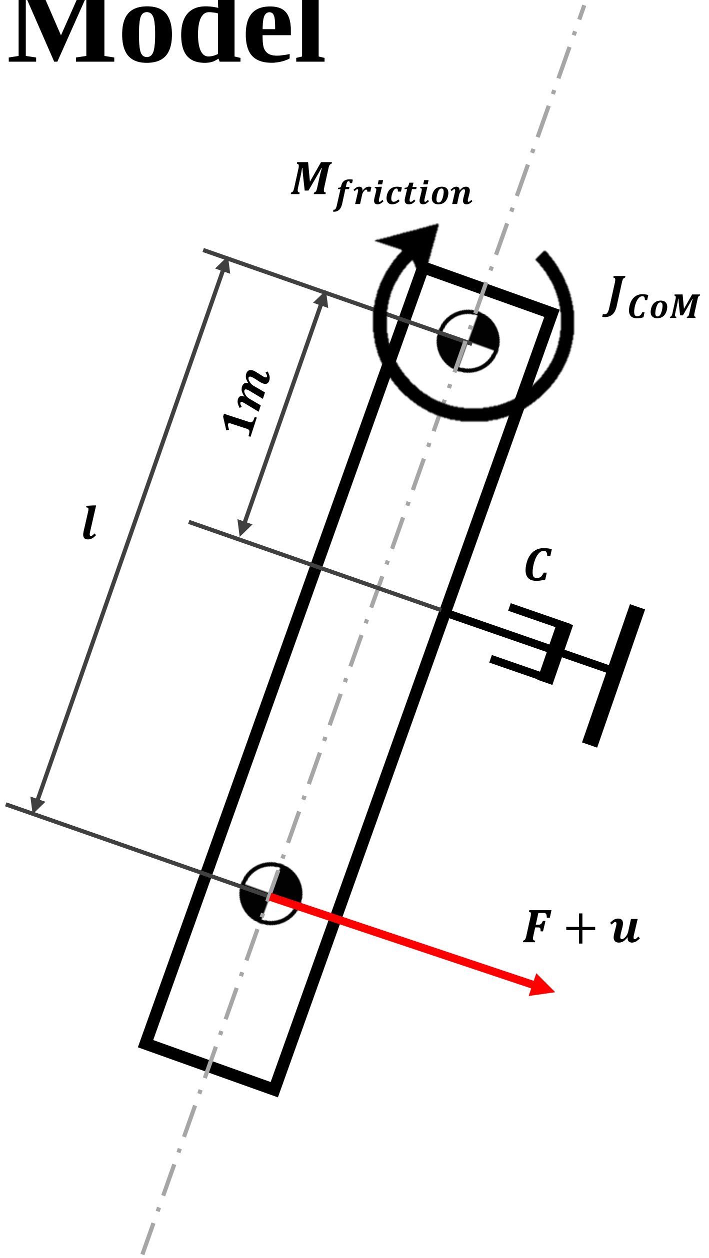
$$Js^2\Theta(s) = -cs\Theta(s) - \{(2a\rho A_{Wing} f v^2(s)\Theta(s)) + (2b\rho A_{Fin} f v^2(s)(\Theta(s) + \Pi(s)))l\}$$



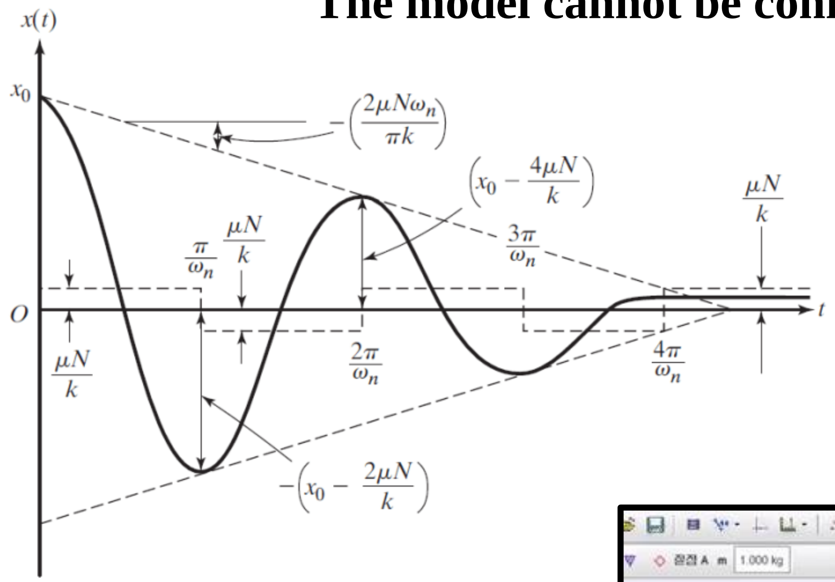
We need $v^2(s)$!

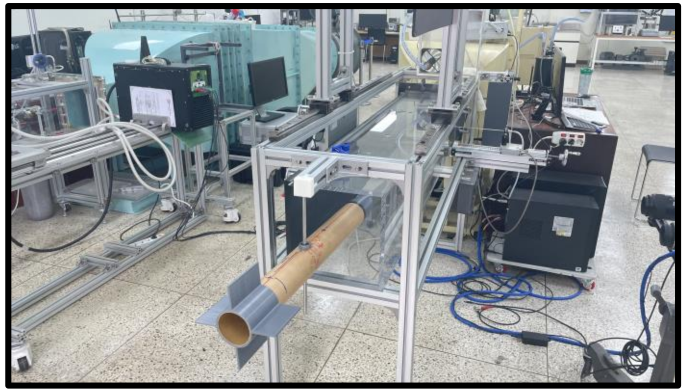
$$\frac{\Theta(s)}{\Pi(s)} = \frac{-2b\rho A_{Fin} f l \; \times v^2(s) l}{[Js^2 + cs + (2a\rho A_{Wing} f + 2b\rho A_{Fin} f l) + v^2(s)]}$$

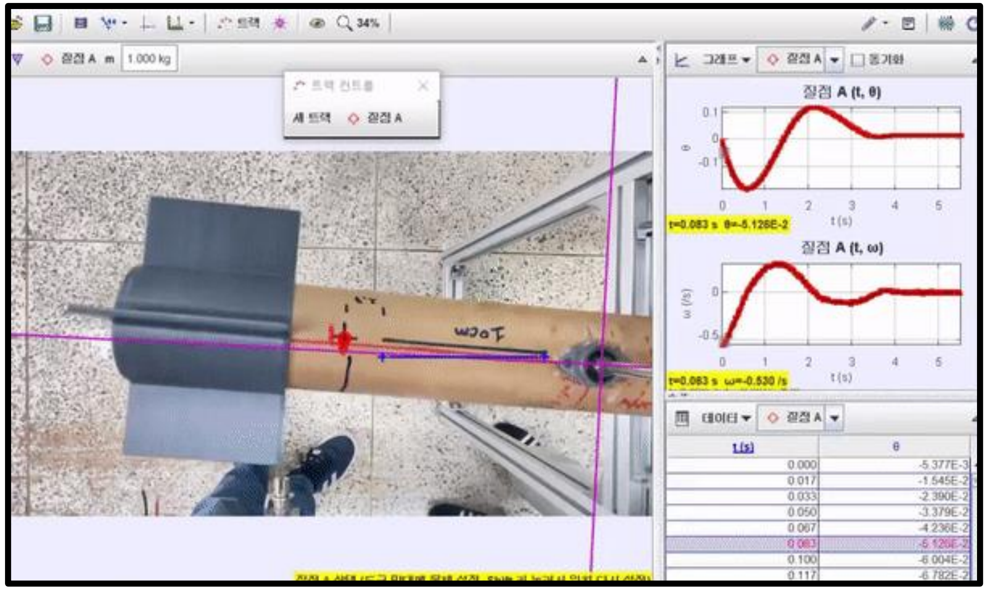
Model



The model cannot be confirmed due to friction of the bearing!



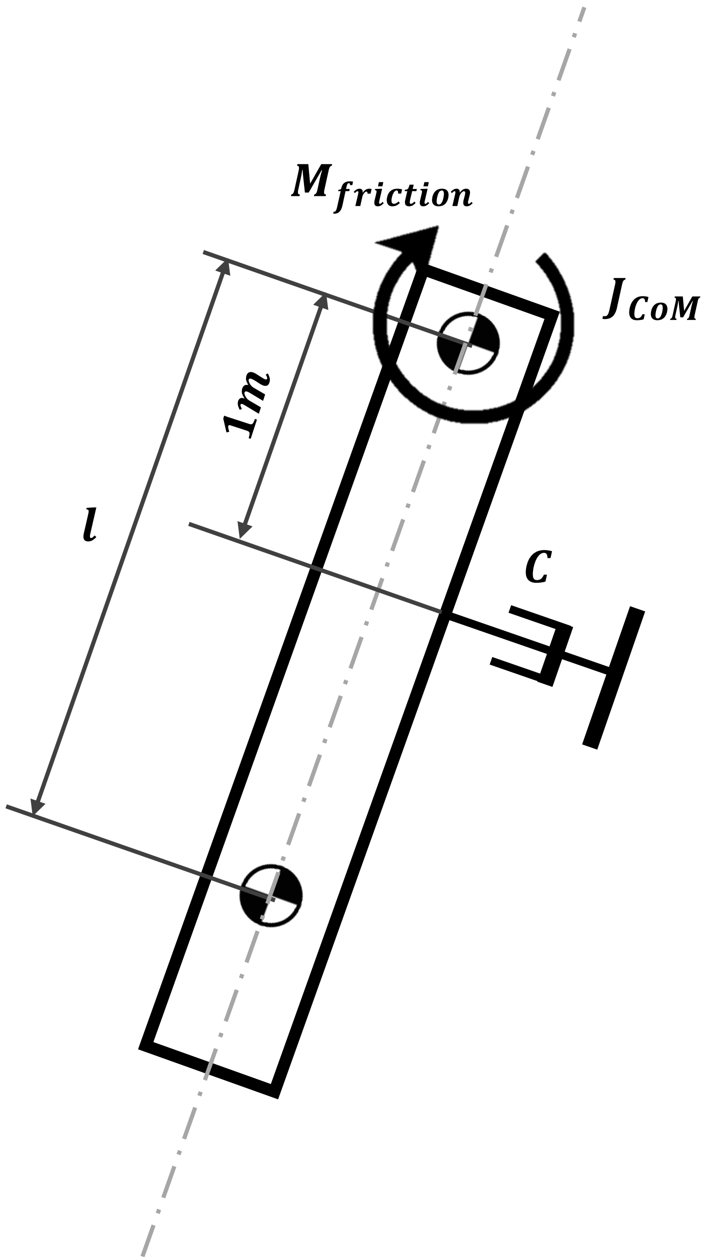




Unknown value

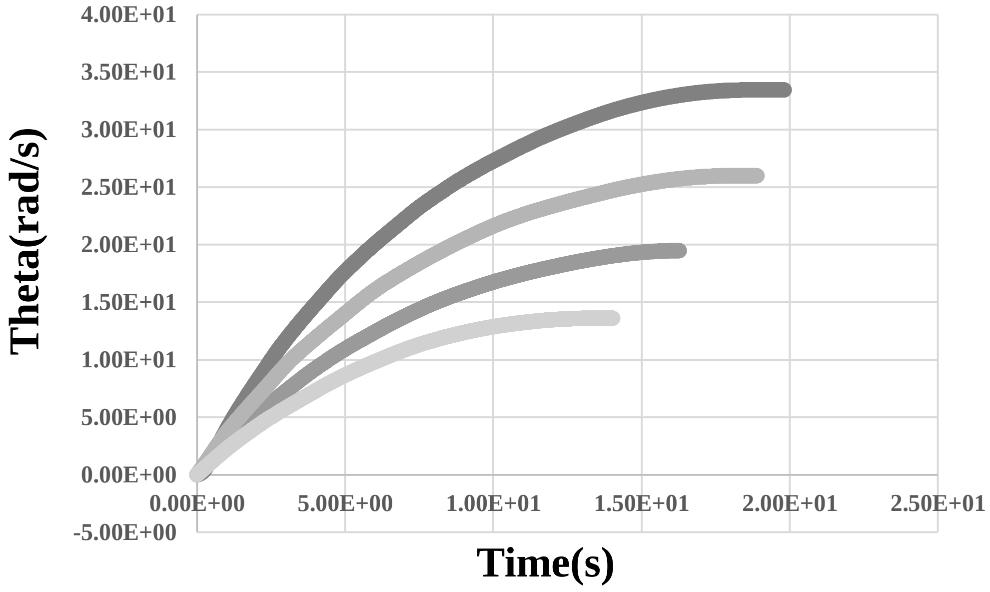
- **damping ratio**
- **friction moment**

Model



$$\begin{cases} J\ddot{\theta} = -c\dot{\theta} - (F+\ \delta)l - M_{friction} \\ J\ddot{\theta} = -c\dot{\theta} - M_{friction} + \delta l \end{cases}$$

Finding Unknown value (c, $M_{friction}$)



Next plan

1. **Filter Complete**