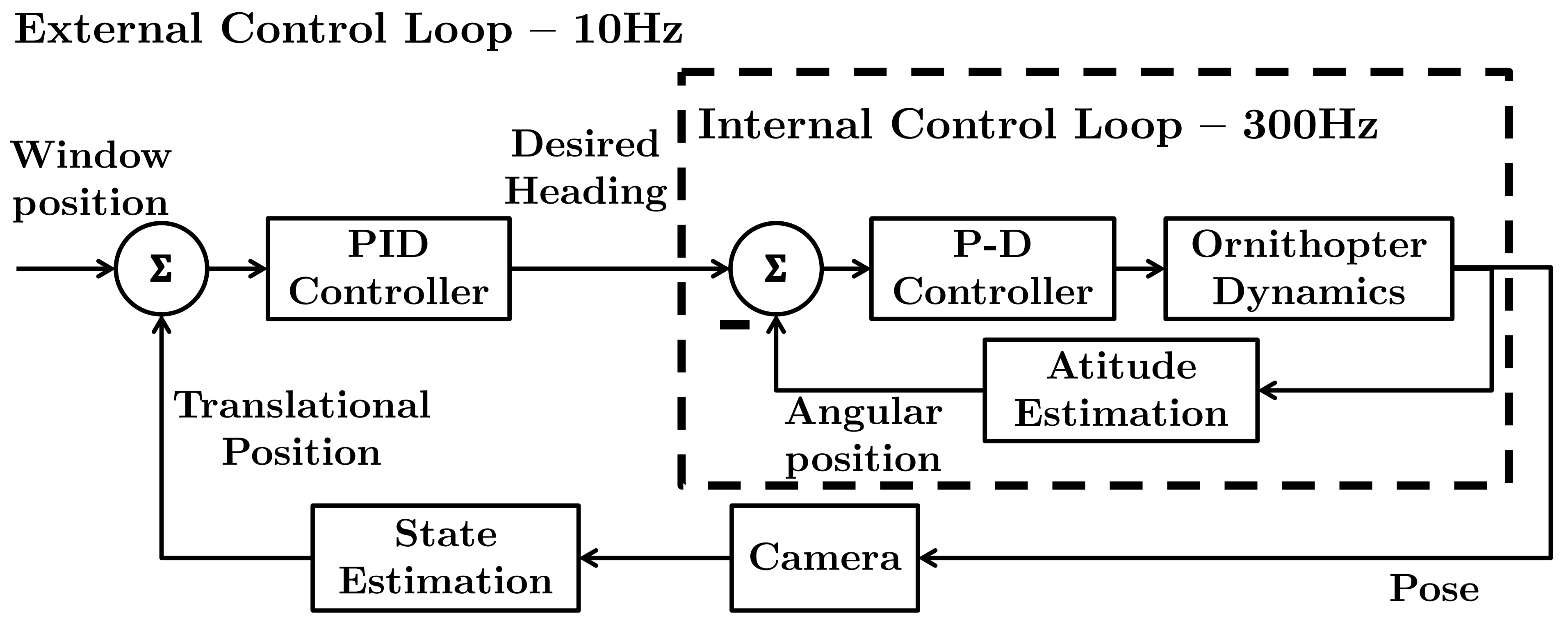
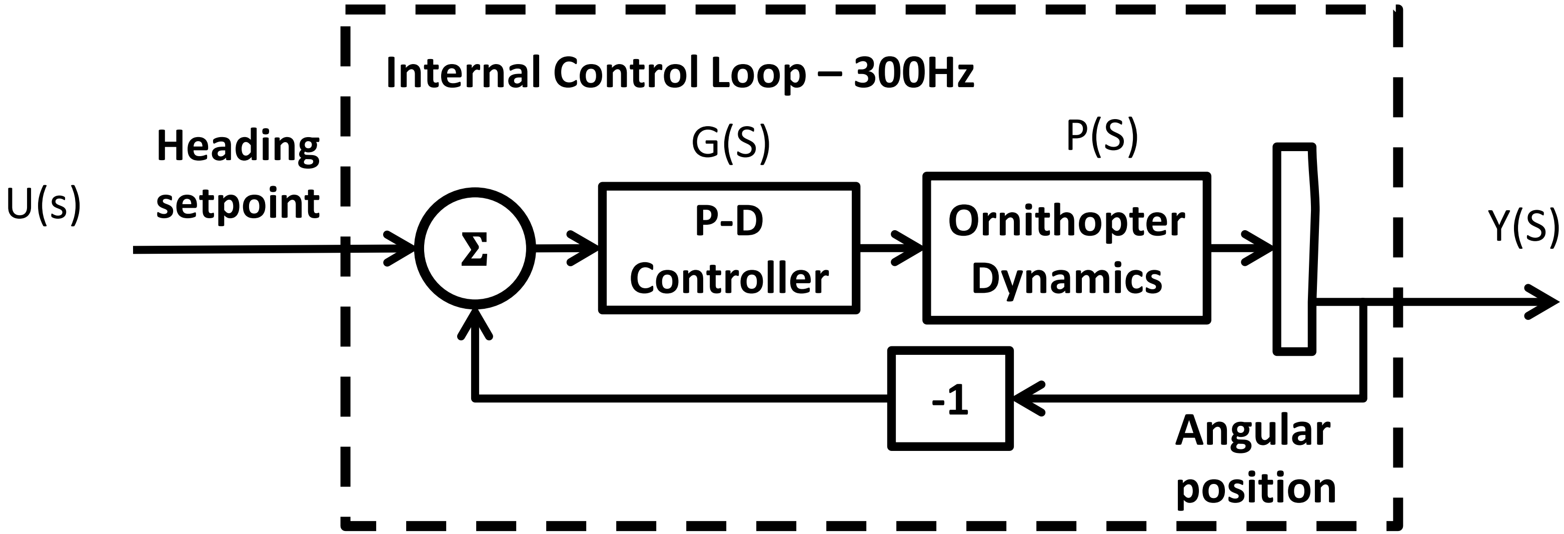

External Control Loop – 10Hz
Internal Control Loop – 300Hz
Window position
Σ
PID Controller
Desired Heading
Σ
P-D Controller
Ornithopter Dynamics
Atitude Estimation
Angular position
Translational Position
State Estimation
Camera
Pose

Internal control loop



Yaw dynamics

$$\begin{bmatrix} \dot{\theta} \\ \dot{\omega} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} \theta \\ \omega \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{r}{I_{zz}} \end{bmatrix} u$$

$$G(s) = \frac{K_D s^2 + K_P s + K_I}{s} = \frac{0.2s^2 + 2.0s}{s}$$

$$P(s) = \frac{\frac{r}{I_{zz}}}{s^2} \qquad M = \frac{r}{I_{zz}}$$

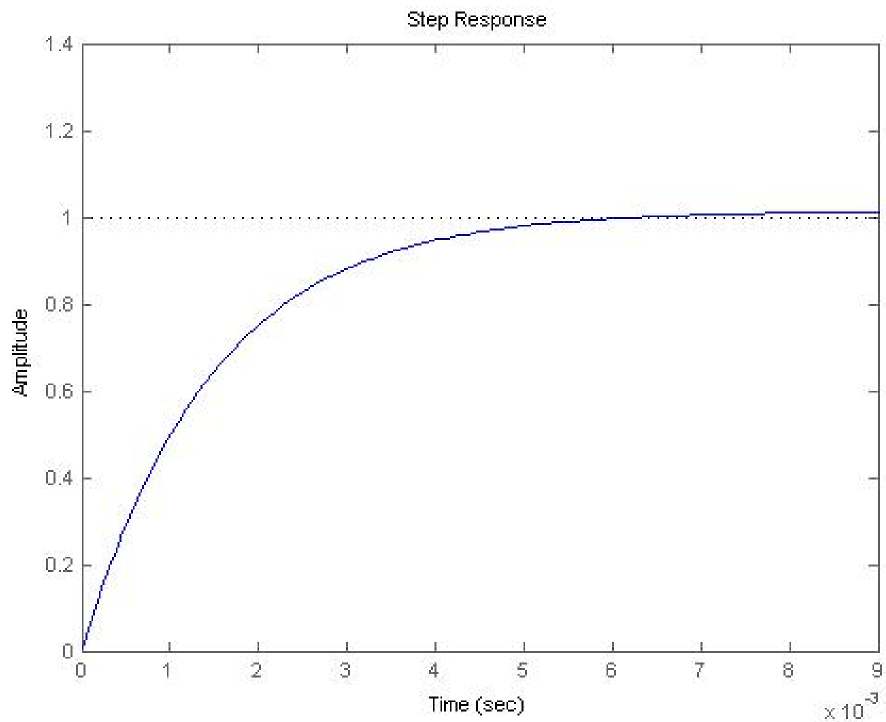
$$\frac{Y(s)}{U(s)} = \frac{G(s)P(s)}{G(s)P(S) + 1} = \frac{M(K_D s^2 + K_P s + K_I)}{s^3 + M(K_D s^2 + K_P s + K_I)}$$

Using Aforementioned Dynamics

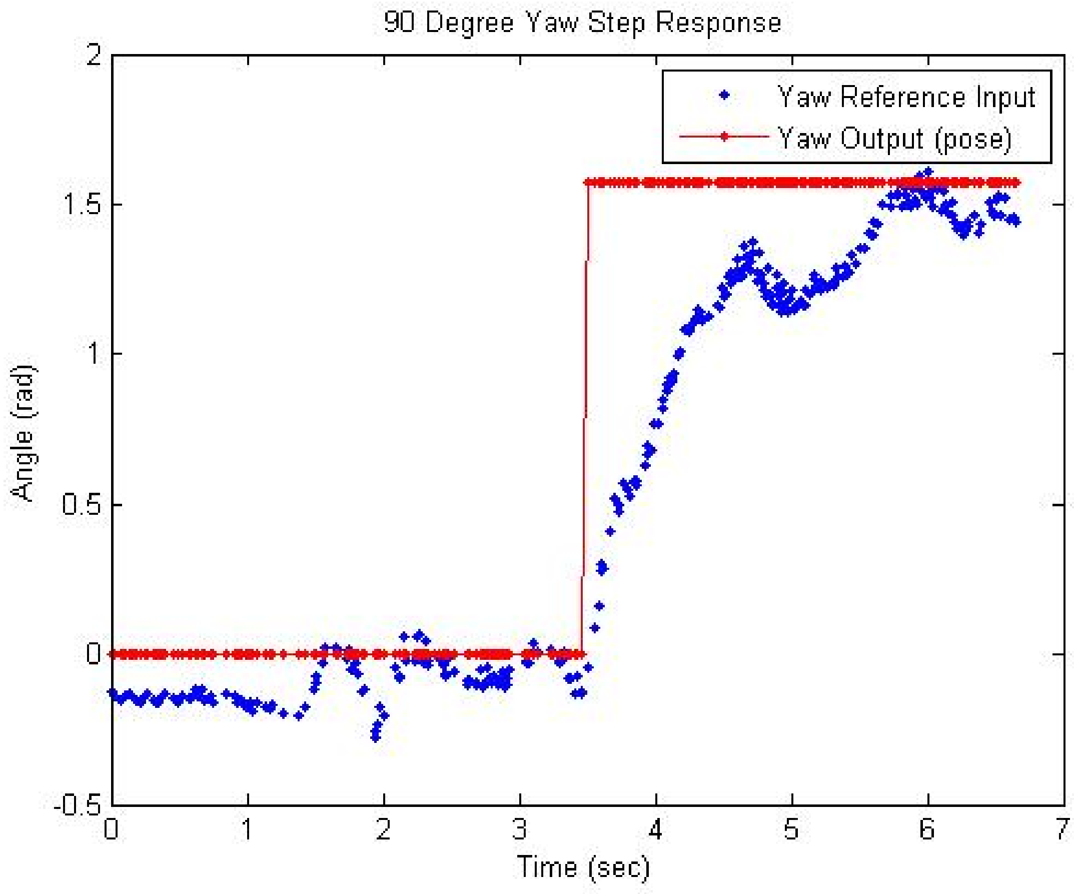
$M = 3426$

$$\frac{Y(s)}{U(s)} = \frac{G(s)P(s)}{G(s)P(S)+1} = \frac{M(K_D s^2 + K_P s + K_I)}{s^3 + M(K_D s^2 + K_P s + K_I)} = \frac{685.2s^2 + 6852s}{s^3 + 685.2s^2 + 6852s}$$
$$= \frac{685.2s + 6852}{s^2 + 685.2s + 6852}$$

step response way too fast
(obvious from large coefficients)

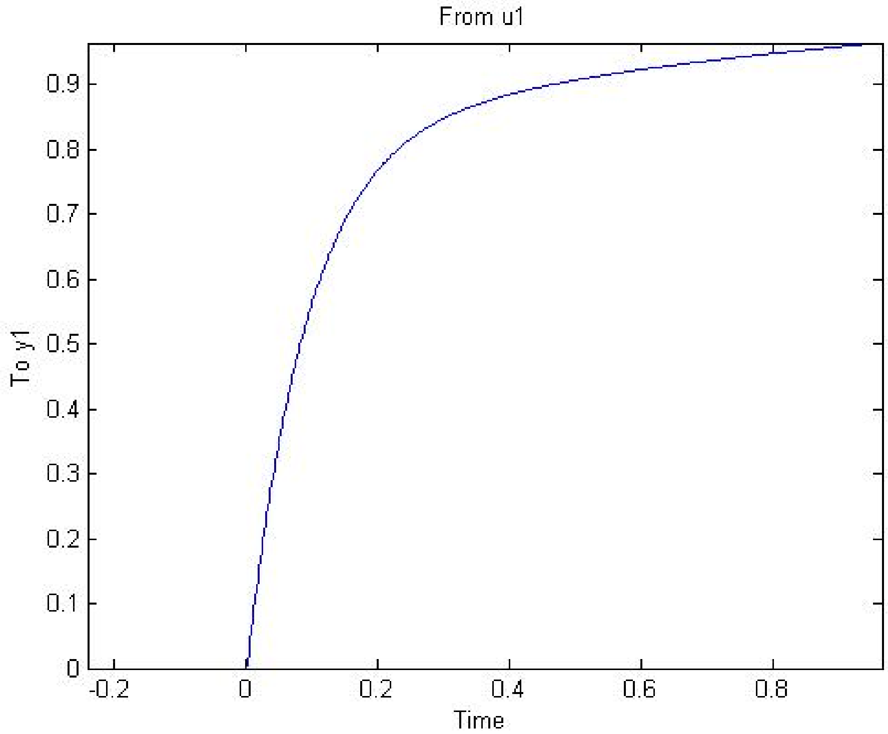


Now estimating transfer function (using MATLAB) since I know its order (more or less) and I have the step response below form experimentation (3 poles, 1 zero)



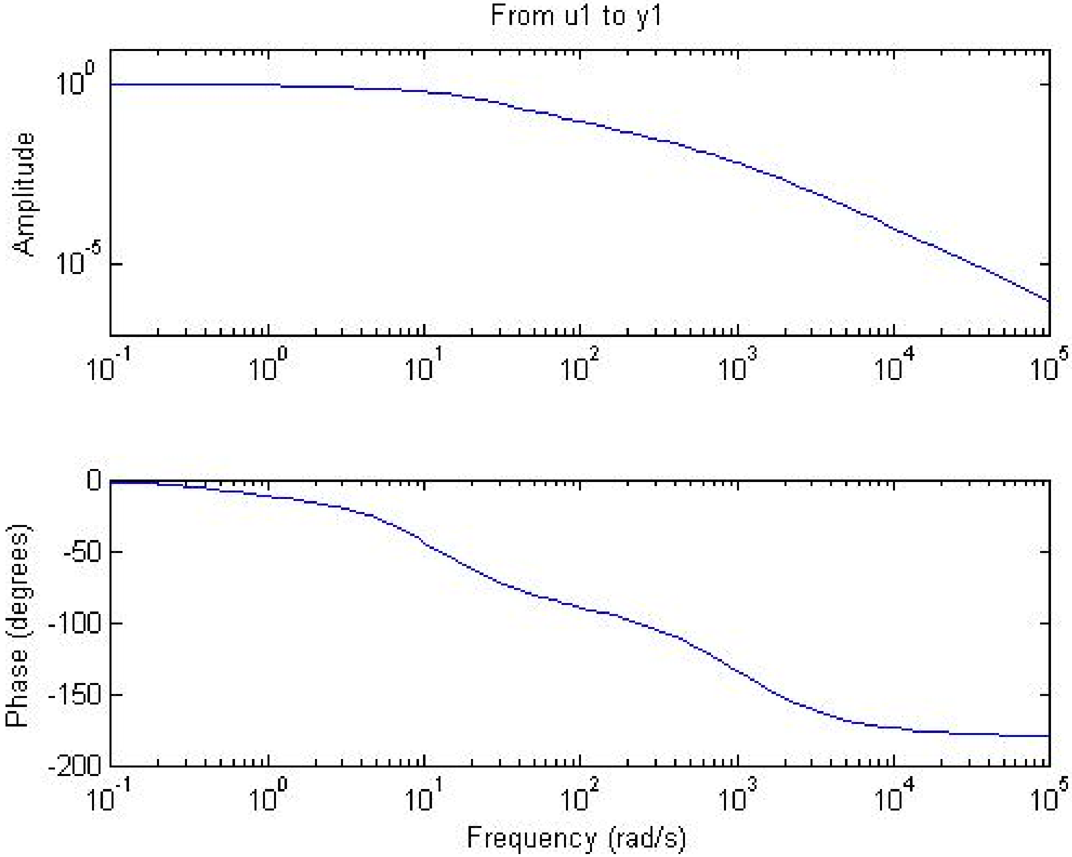
Estimated Transfer Function

$$G(s) = \frac{1.049(1 + 0.7534s)}{(1 + 0.09019s)(1 + 0.94577s)(1 + 0.001s)}$$



Freq/Stability

Zeros: -1.3273
Poles: -1000, -11.0877, -1.0573



- Visio
- Cmu serif
- 2^{nd} order fit