Math section

$\dot{x}(t) = \lambda x(t) - m x(t - T_d)$ ... (1)

where from our non linearity calculation.

$\xi(t) = \xi_0 e^{\lambda t}$; $G = \xi(t)/\xi_0$

$t_{non-lin} = \frac{\ln G}{\lambda}$; we placed G between 10 and 100

giving $t_{non-lin} \in [2.303\, \tau_A, 4.606\, \tau_A]$

so T_{d_max} for linear regime is $\leq 2.303\, \tau_A$ to $4.606\, \tau_A$
acc. to given parameters of G

Why linear regime? [will get to this]

$s = \lambda - m e^{-sT_d}$

$Re(s) = \lambda - m e^{-Re(s) T_d} \cos(Im(s) T_d)$
$Im(s) = m e^{-Re(s) T_d} \sin(Im(s) T_d)$

Now $Re(s) = c\lambda$, c : reduction factor

$c\lambda = \lambda - m e^{-c\lambda T_d}$ T_d is in the form $F \tau_A = \frac{F}{\lambda}$

$\Rightarrow \lambda - \lambda c = m e^{-cF}$ ... we can plot this.

$L_B < F < 4.606\,\tau_A$

L_B is our lower bound based on our hardware latency budget.

λ is constant
m is assumed constant for this math. albeit m's strength depends on the latency of our control law.

m, likely an inductor will ramp up from 0 to m

c our reduction factor will be determined for various values of F

$$\ln(\lambda) + \ln(1-c) = \ln(m) - cF$$

$$cF + \ln(1-c) = \ln(m) - \ln(\lambda)$$

$$cF + \ln(1-c) = \ln\left(\frac{m}{\lambda}\right)$$

$$\ln\left(e^{cF}(1-c)\right) = \ln\left(\frac{m}{\lambda}\right)$$

$$e^{cF}(1-c) = \frac{m}{\lambda} = \text{constant } \beta$$

$$e^{cF}(1-c) = \beta$$