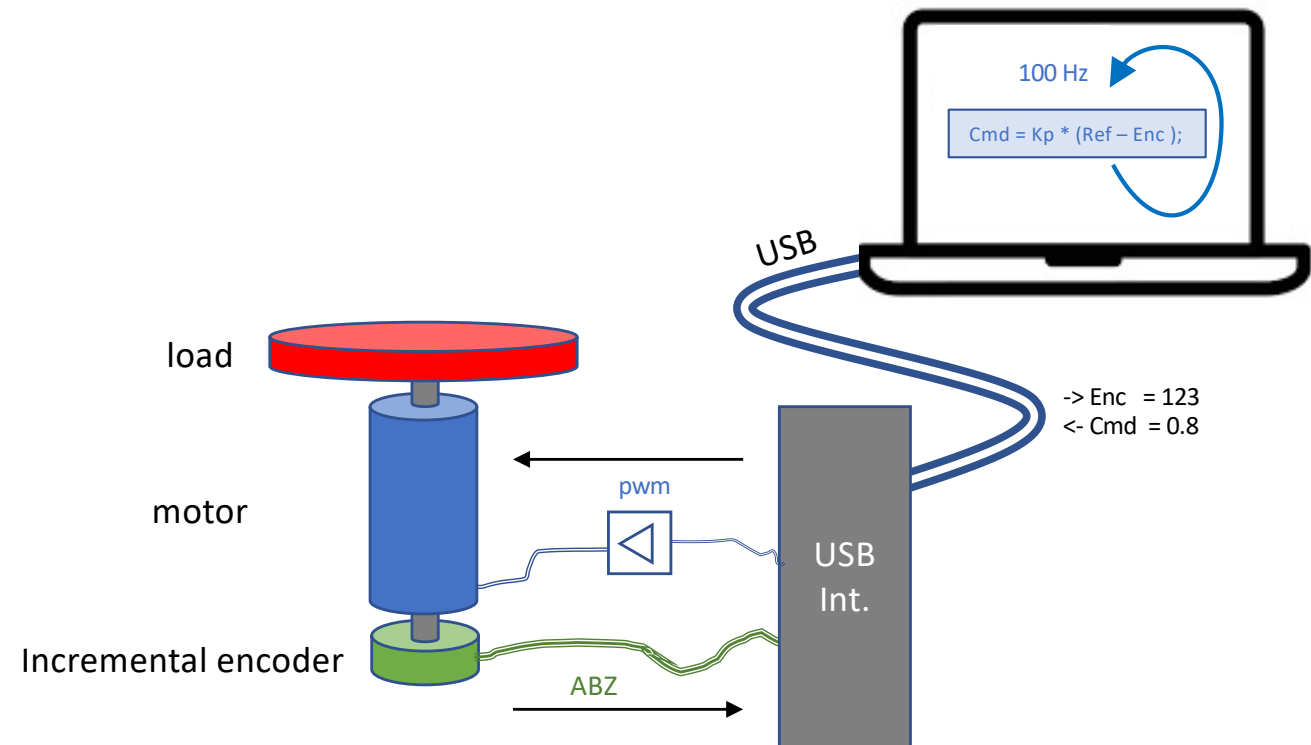


PID Implementation

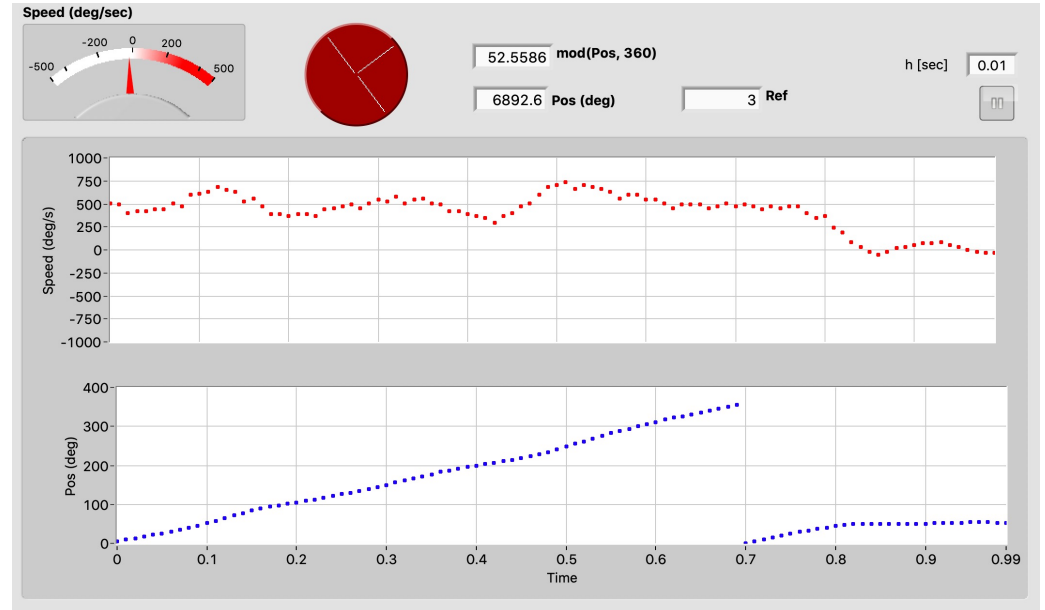
2021 QUBE



Demo time



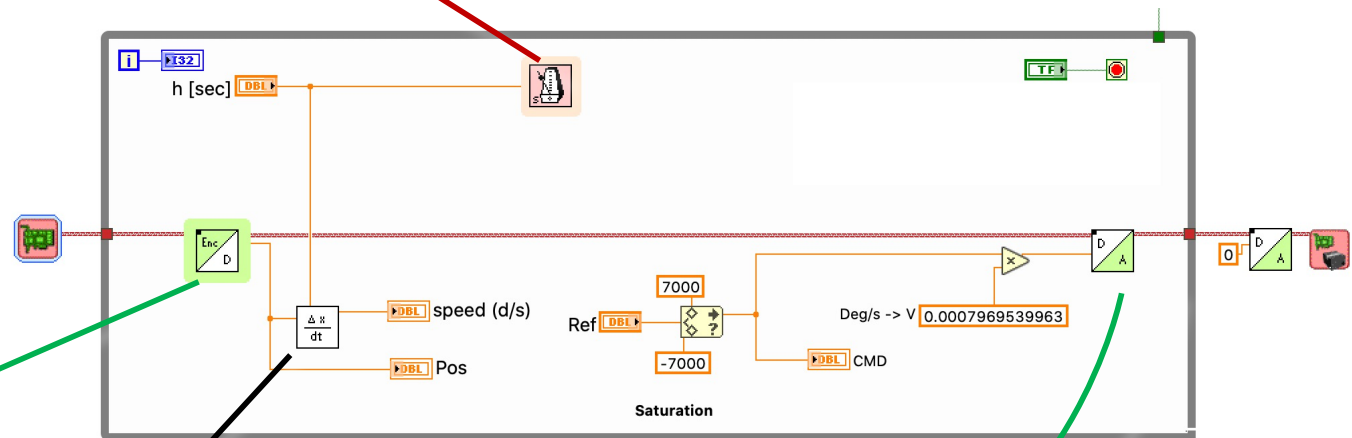
LabVIEW implementation



Enc

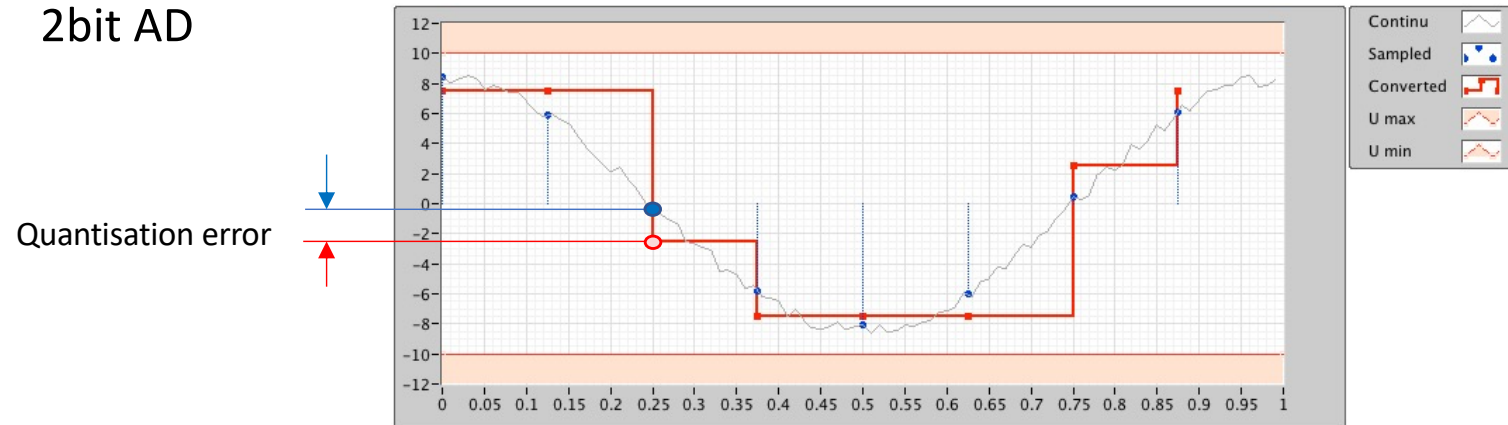
D/A

Pos -> speed

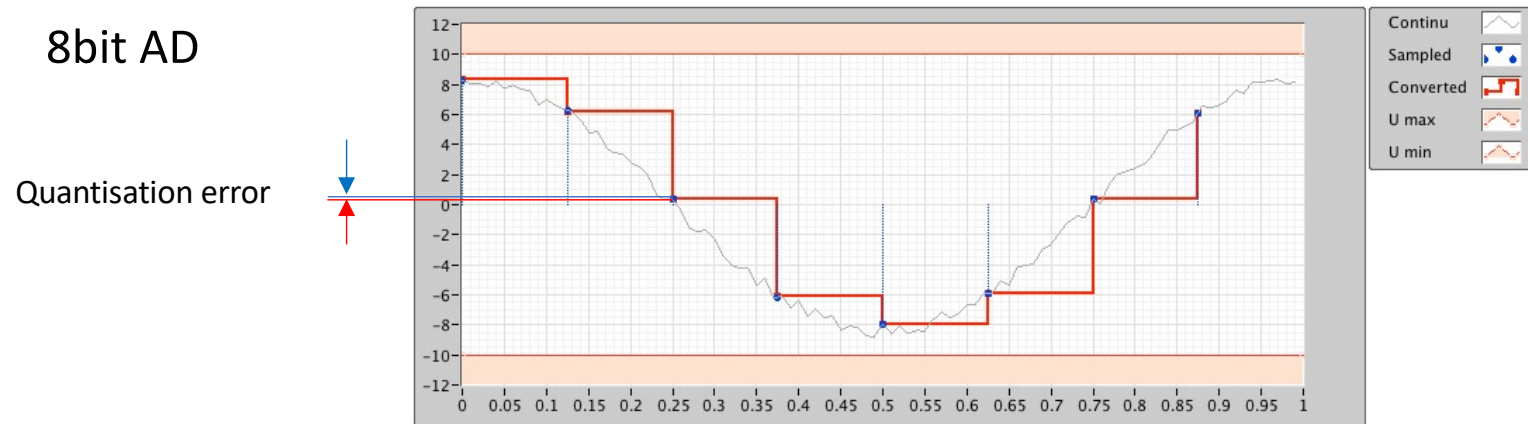


LabVIEW implementation, *AD-DA simulation*

2bit AD

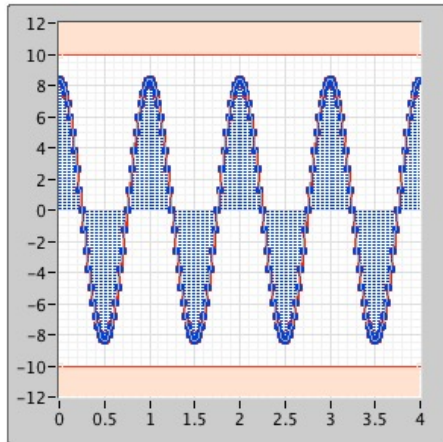


8bit AD

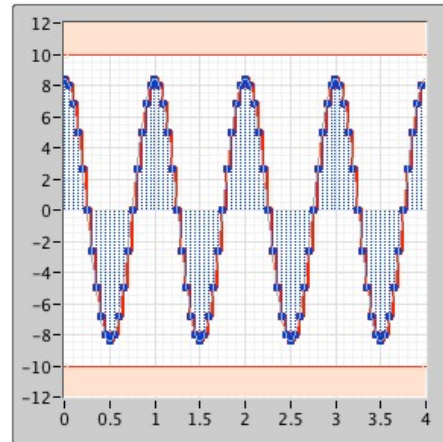


LabVIEW implementation, *AD-DA simulation*

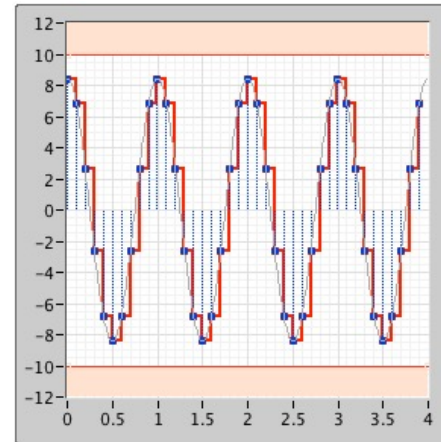
Sample at least at twice the frequency you want to observe ($> 10\text{-}40\times$ in practice)



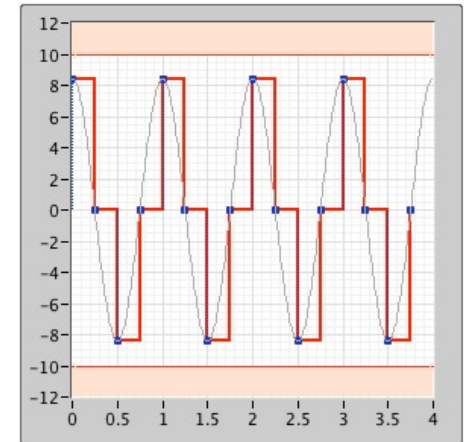
$$f_e = 40 \times f$$



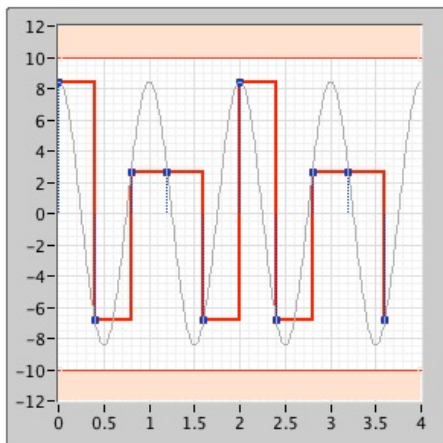
$$f_e = 20 \times f$$



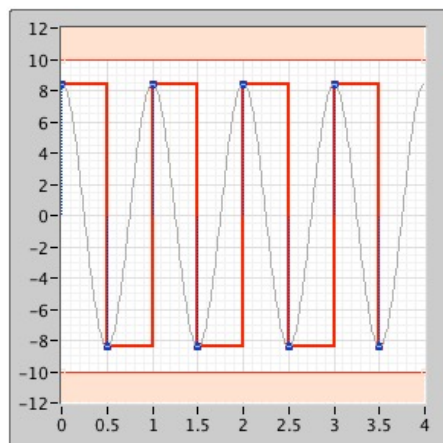
$$f_e = 10 \times f$$



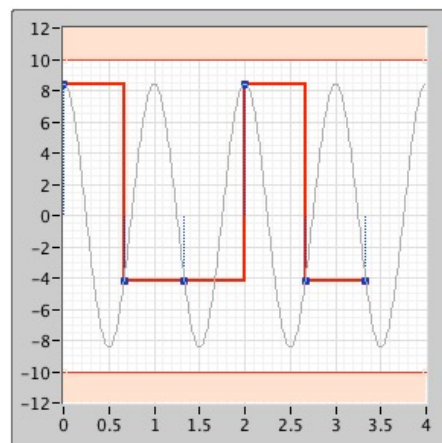
$$f_e = 5 \times f$$



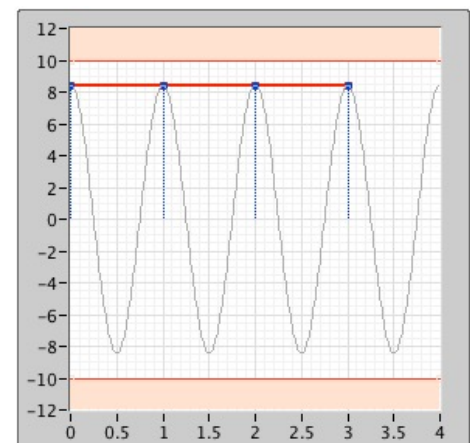
$$f_e = 2.5 \times f$$



$$f_e = 2 \times f$$



$$f_e = 1.5 \times f$$



$$f_e = f$$

LabVIEW implementation, T ??

Sample at least at twice the frequency you want to observe (> 10-40 in practice)

Guesstimate for a 1st order system

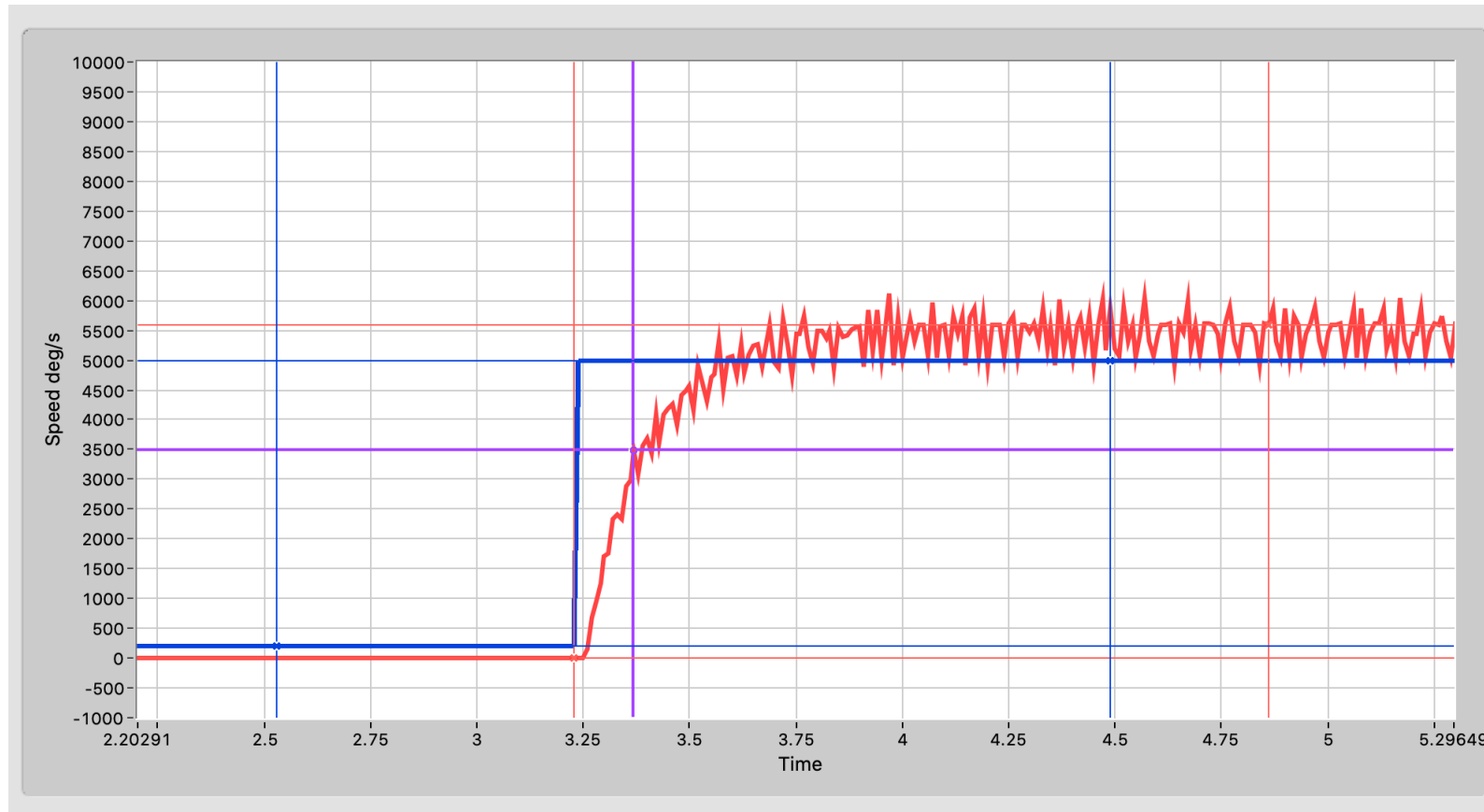
τ defines the ω_0 , we should sample at $\sim 20 \omega_0 \rightarrow \omega_e = 20\omega_0$

$$\omega_e = \frac{2\pi}{T} , \quad \omega_0 = \frac{1}{\tau} \quad \Rightarrow \quad \frac{2\pi}{T} = \frac{20}{\tau}$$

$$T = \frac{2\pi\tau}{20} = \frac{\tau}{2\div 5}$$

h is also often used to define the sampling period T

Step response in speed

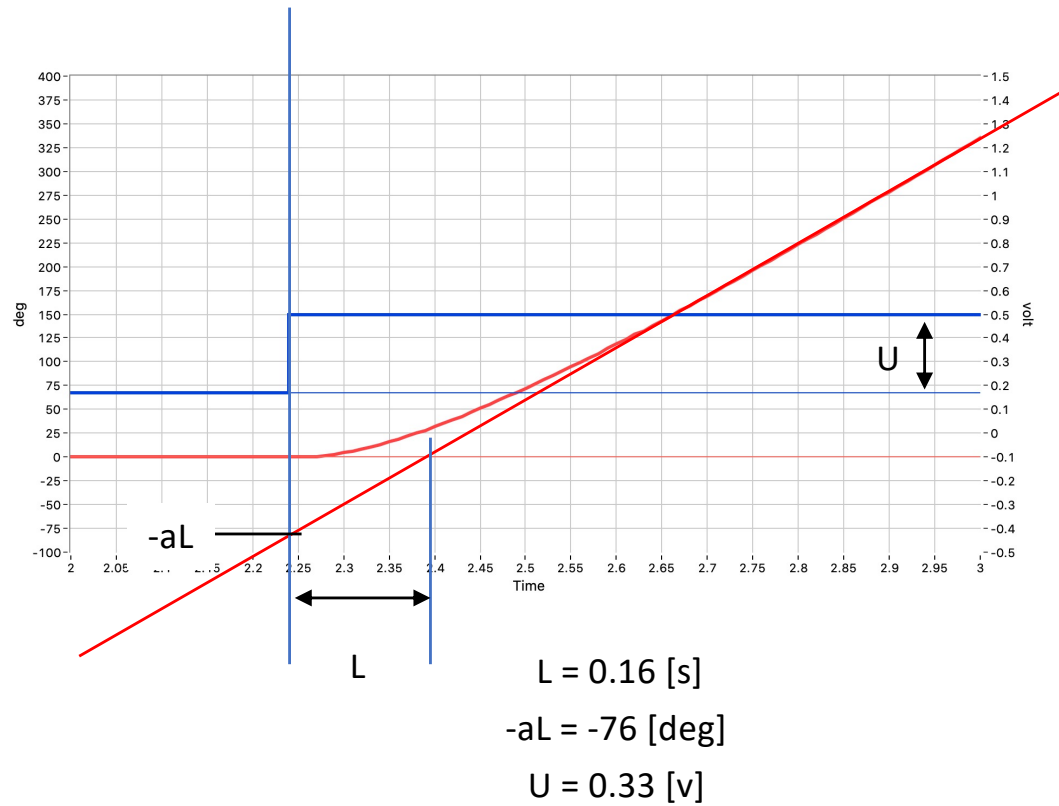


$$\tau = 0.14 \text{ [s]}$$

$$\gamma = 1.18$$

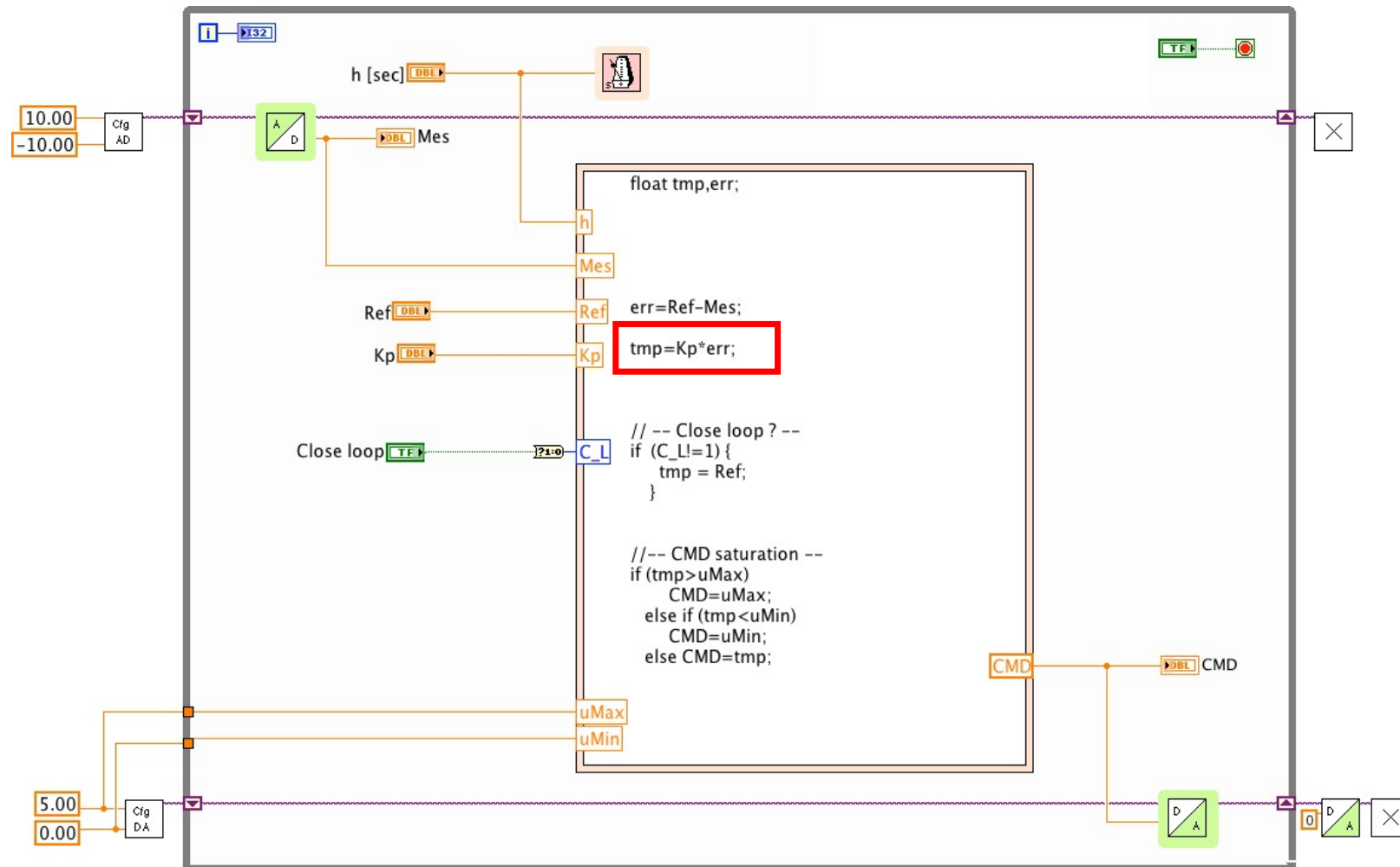
$$T = \frac{0.14}{\sim 5} = < 0.03 \text{ [s]}$$

Z-N QUBE in position

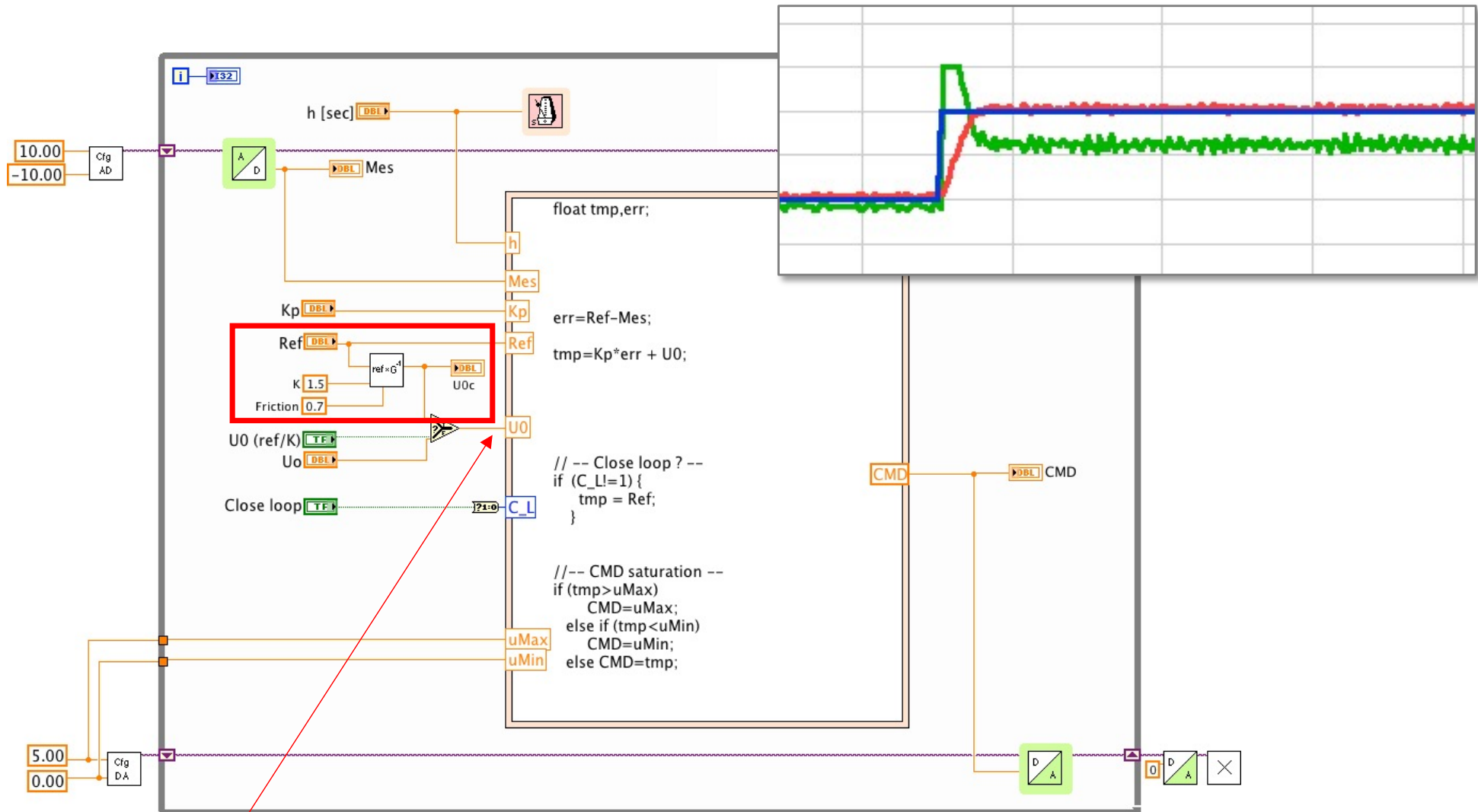


Controller	K_p	T_i	T_d
P	U/aL 0.0043	-	-
PI	$0.9U/aL$ 0.0039	$3.3 L$ 0.52	-
PID	$1.2U/aL$ 0.0052	$2 L$ 0.32	$L/2$ 0.08

LabVIEW implementation, P controller

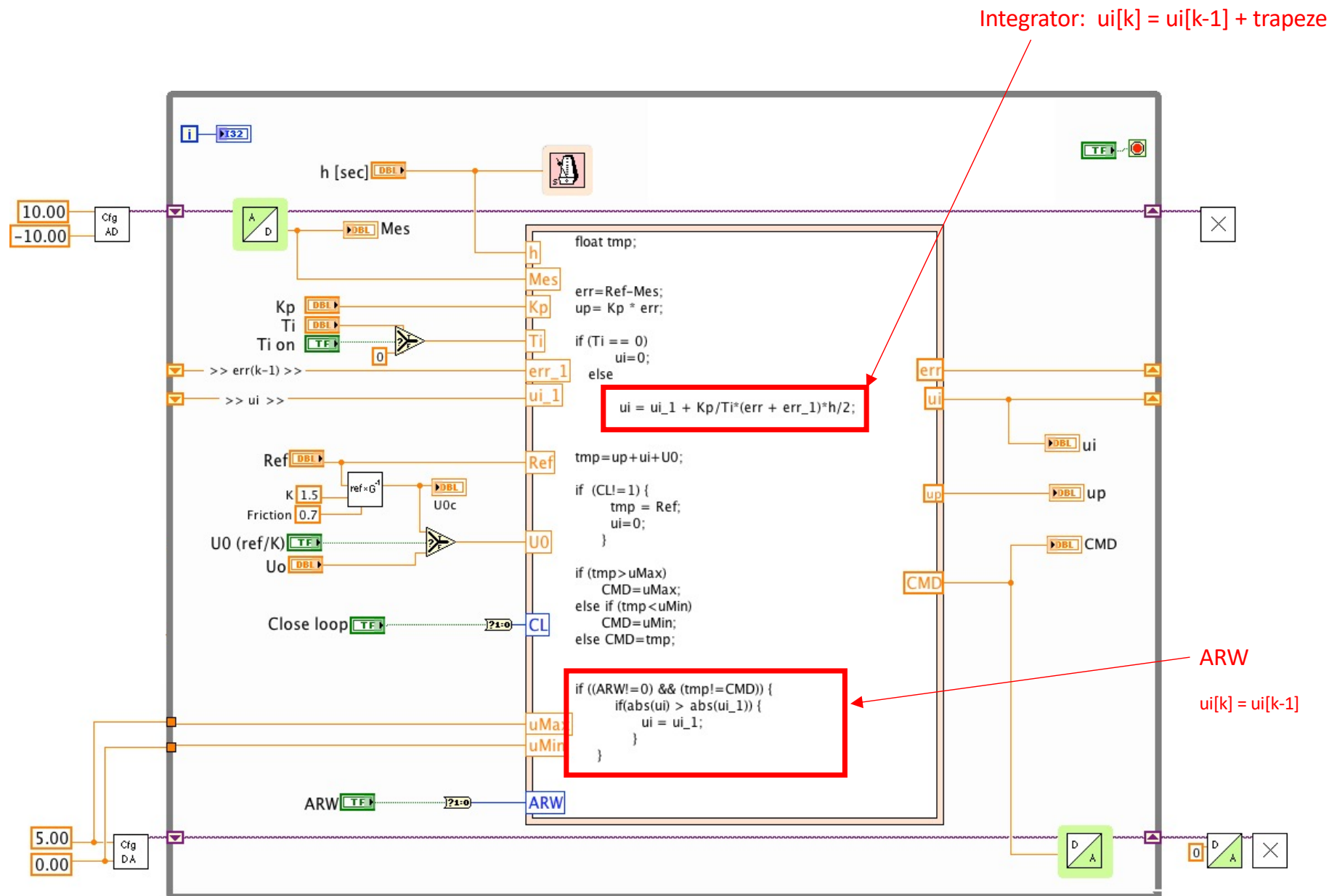


LabVIEW implementation, P controller + feed forward

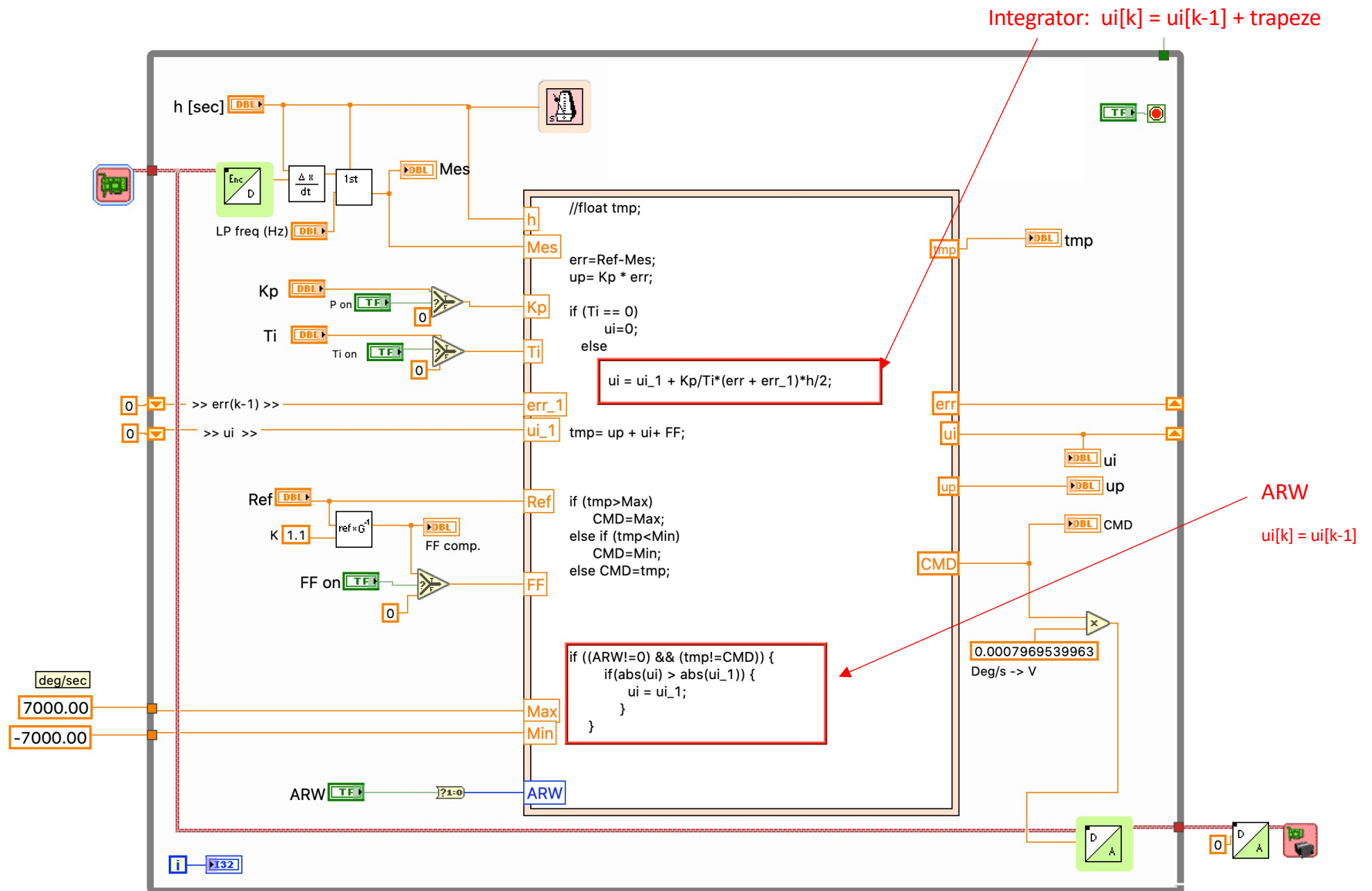


$$U0c = \frac{Ref}{K} + Friction$$

LabVIEW implementation, PI controller + ARW

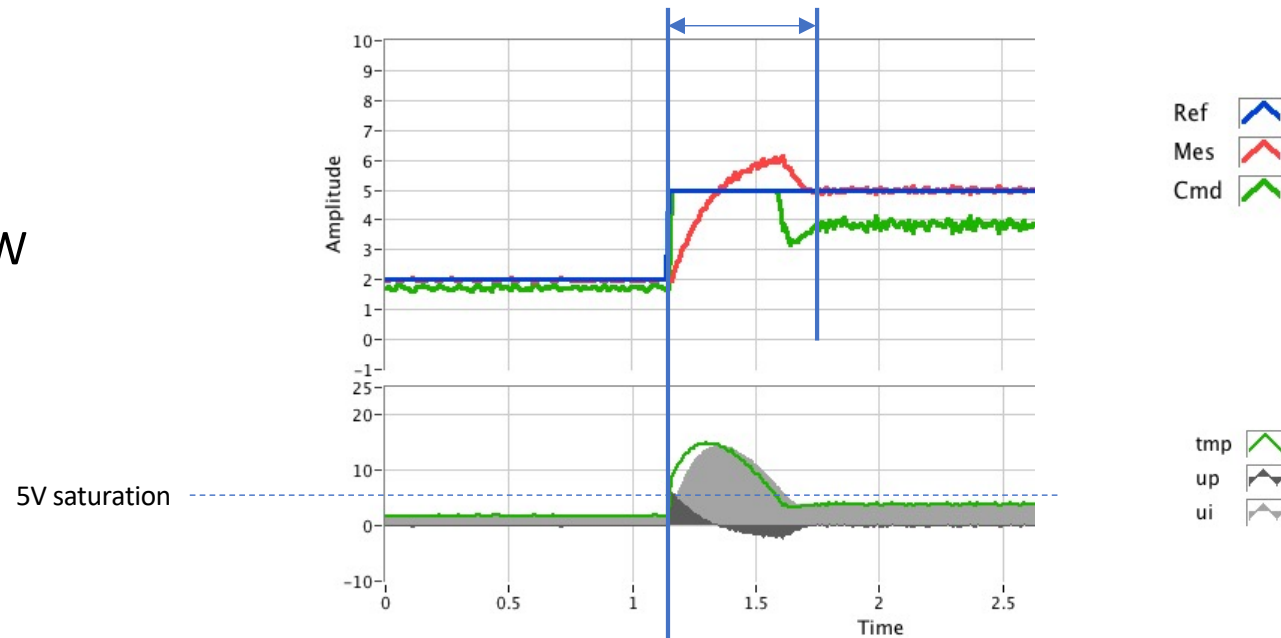


LabVIEW implementation, PI controller + ARW

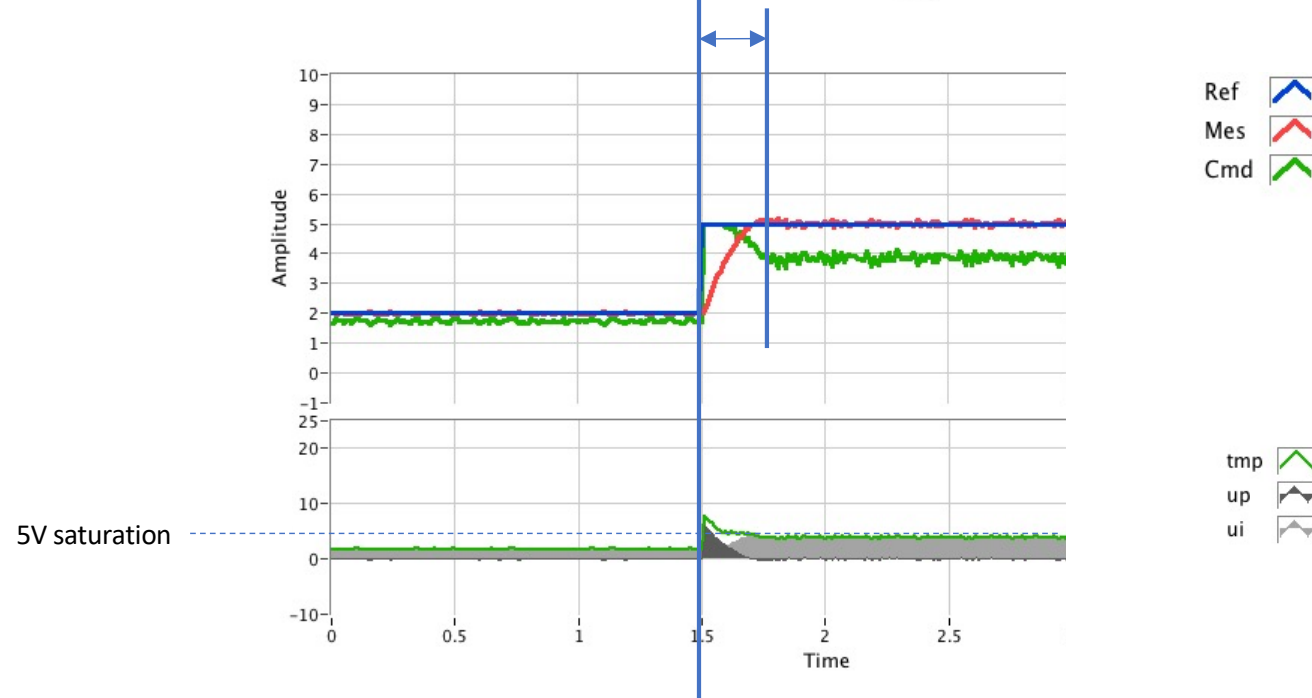


LabVIEW implementation, PI controller + ARW

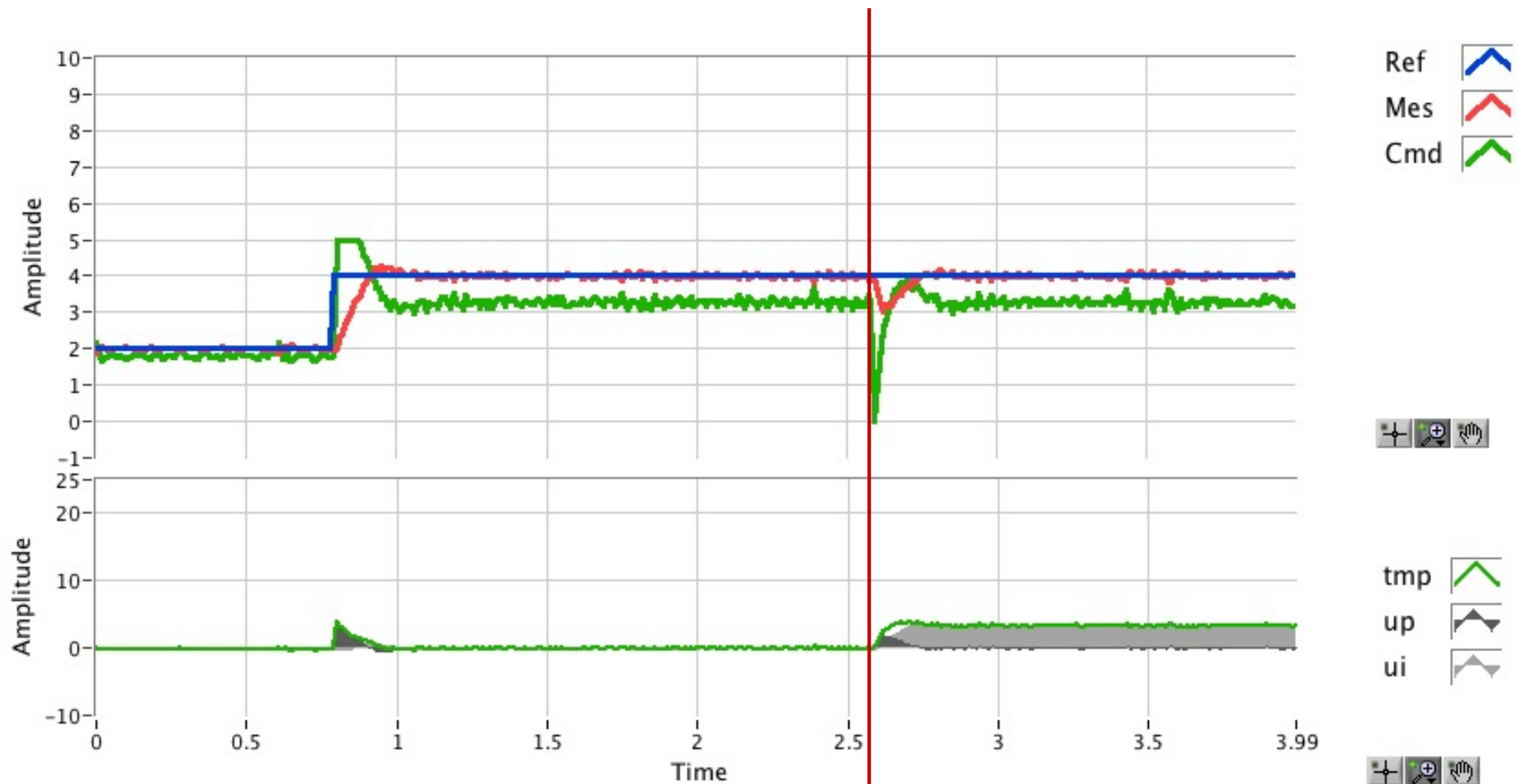
PI without ARW



PI with ARW



LabVIEW implementation, PI controller vs Feedforward



Feed forward activated

The controller ($up+ui$) does not contribute to the command once the transition phase is over

Feed forward deactivated

The controller ($up+ui$) contributes to the command, mainly ui

LabVIEW implementation, bad T with PI controller

$\tau = 0.17$ [s]

