Tracking Control

MCHE 470: Robotics

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Zero Phase Error Tracking Control Example

- System is:

$$H(z) = \frac{b(z+0.26)(z+3.64)}{(z-0.5)^3}$$

Simulation Parameters

- Sampling Rate - $T_s = 0.1s$

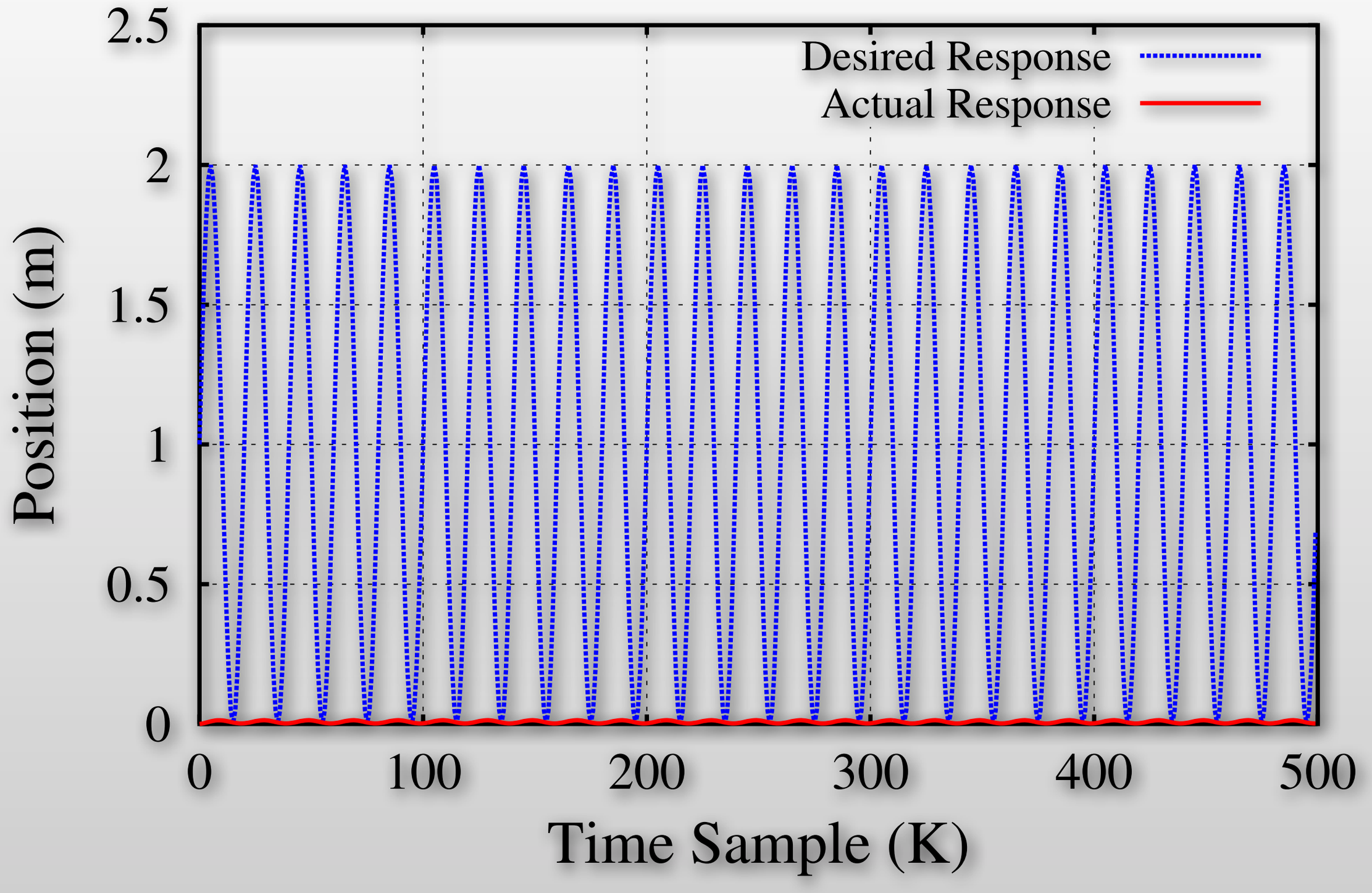
- $N=20$ - number of samples per cycle

- Desired trajectory - 0.5Hz sine wave

$$y_d(t) = 1 + \sin(\pi t)$$

$$y_d(k) = 1 + \sin\left(\frac{2\pi k}{N}\right)$$

Without ZPETC



ZPETC

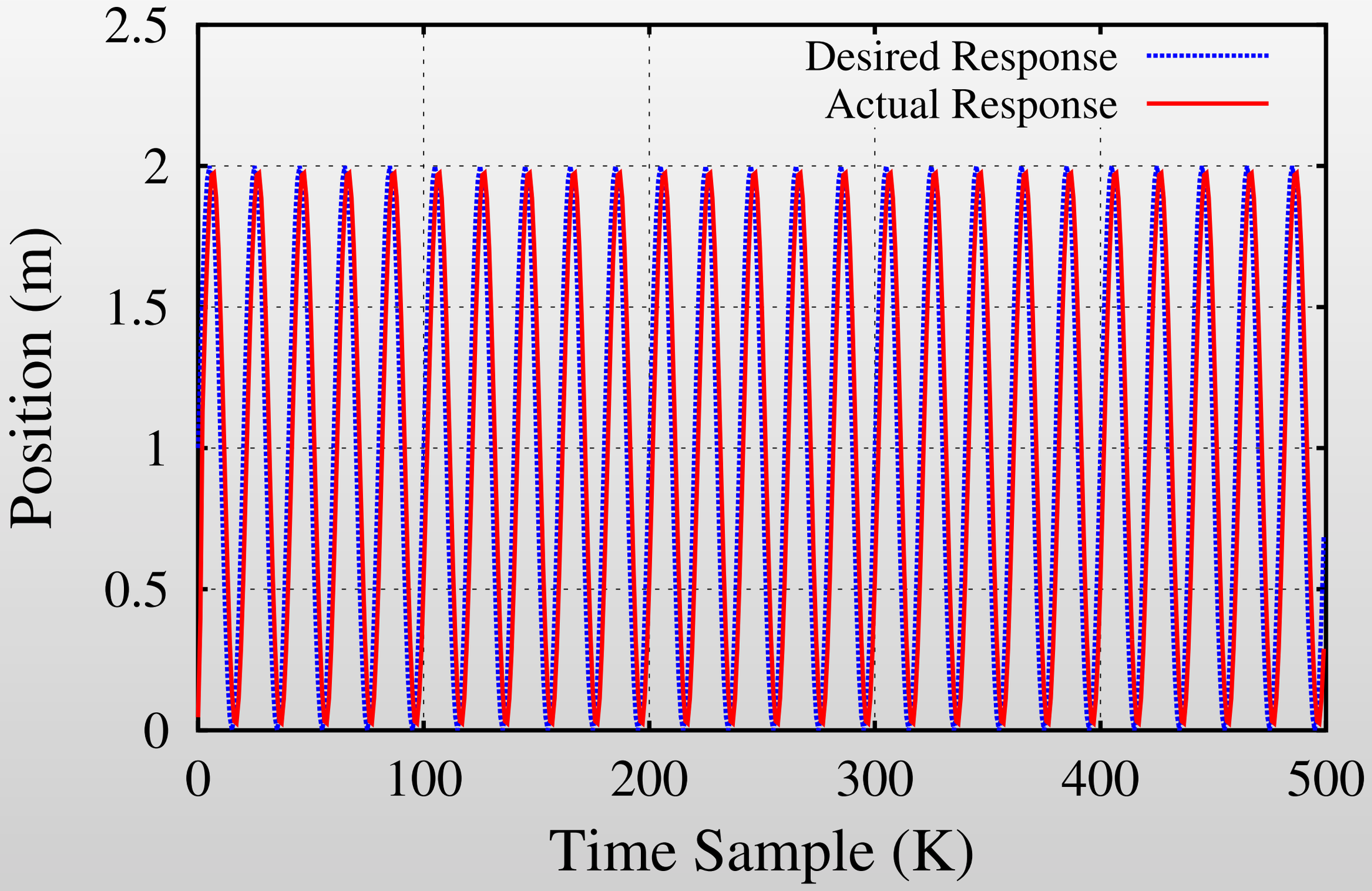
- Don’t invert the zero at 3.64:

$$H(z) = \frac{b(z+0.26)(z+3.64)}{(z-0.5)^3}$$

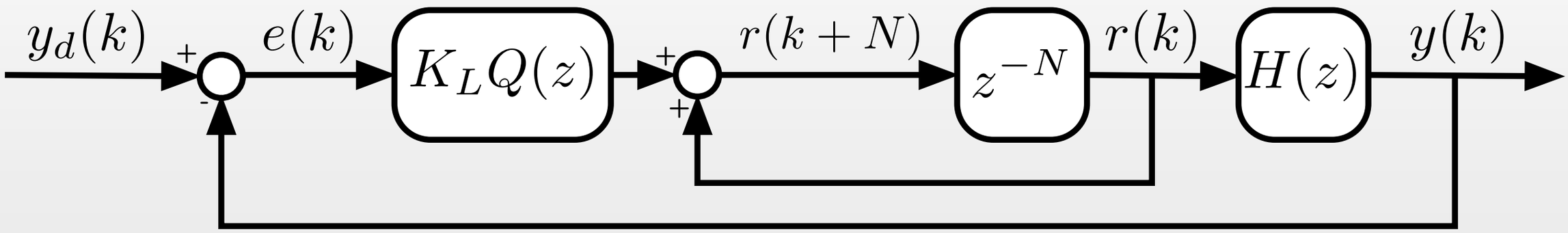
- So the ZPETC is:

$$ZPETC = \frac{(z-0.5)^3(z+3.64)}{b(z+0.26)(1+3.64)^2}$$

ZPETC Response



Repetitive Control Example



$$H(z) = \frac{b(z+0.26)(z+3.64)}{(z-0.5)^3}$$

- $Q(z)$ - ZPETC with approx. values for zeros

$$Q(z) = \frac{(z-0.5)^3(3+z^{-1})}{16b(z+0.2)}$$

Simulation Parameters

- Sampling Rate - $T_s = 0.1s$

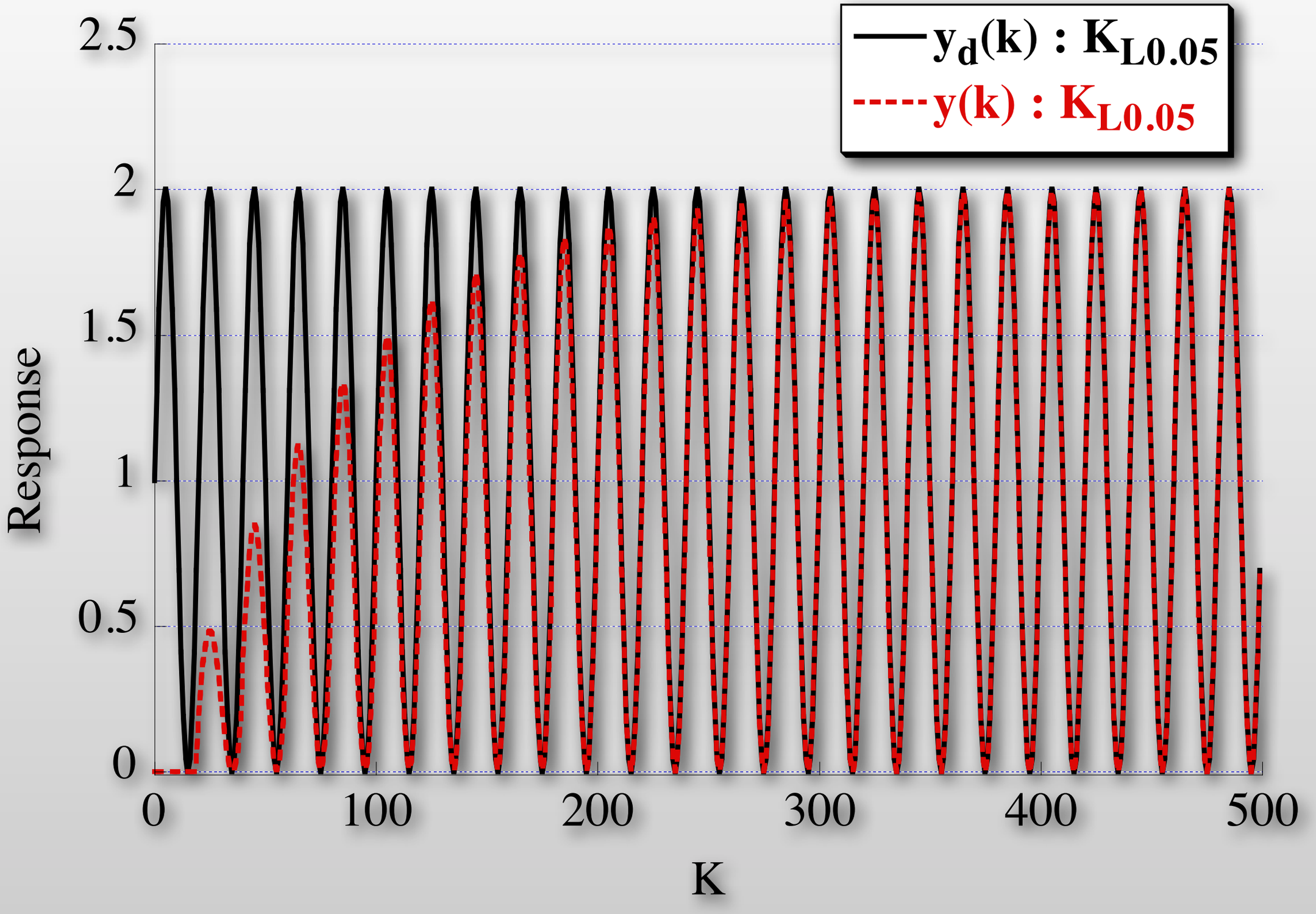
- $N=20$ - number of samples per cycle

- Desired trajectory - 0.5Hz sine wave

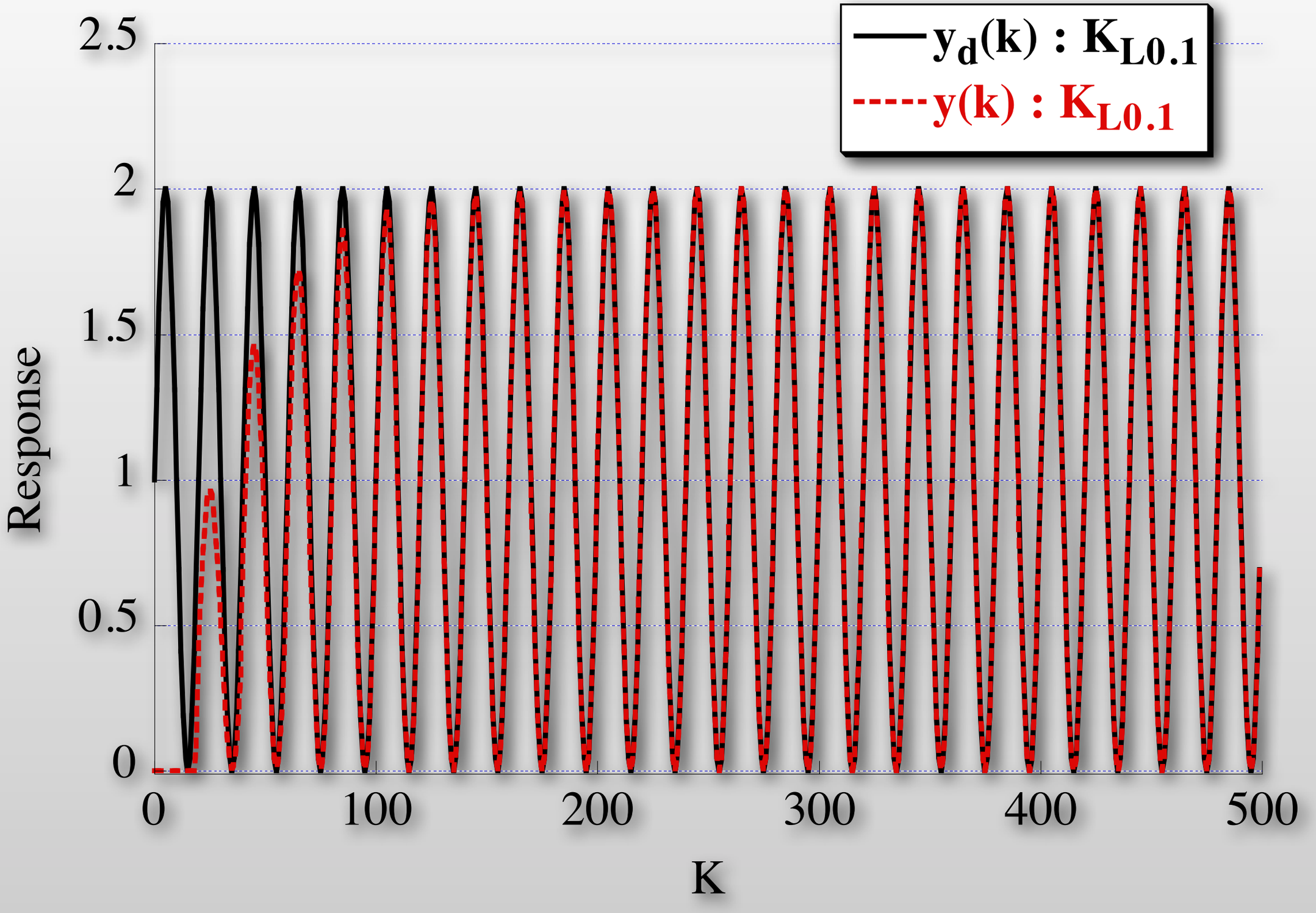
$$y_d(t) = 1 + \sin(\pi t)$$

$$y_d(k) = 1 + \sin\left(\frac{2\pi k}{N}\right)$$

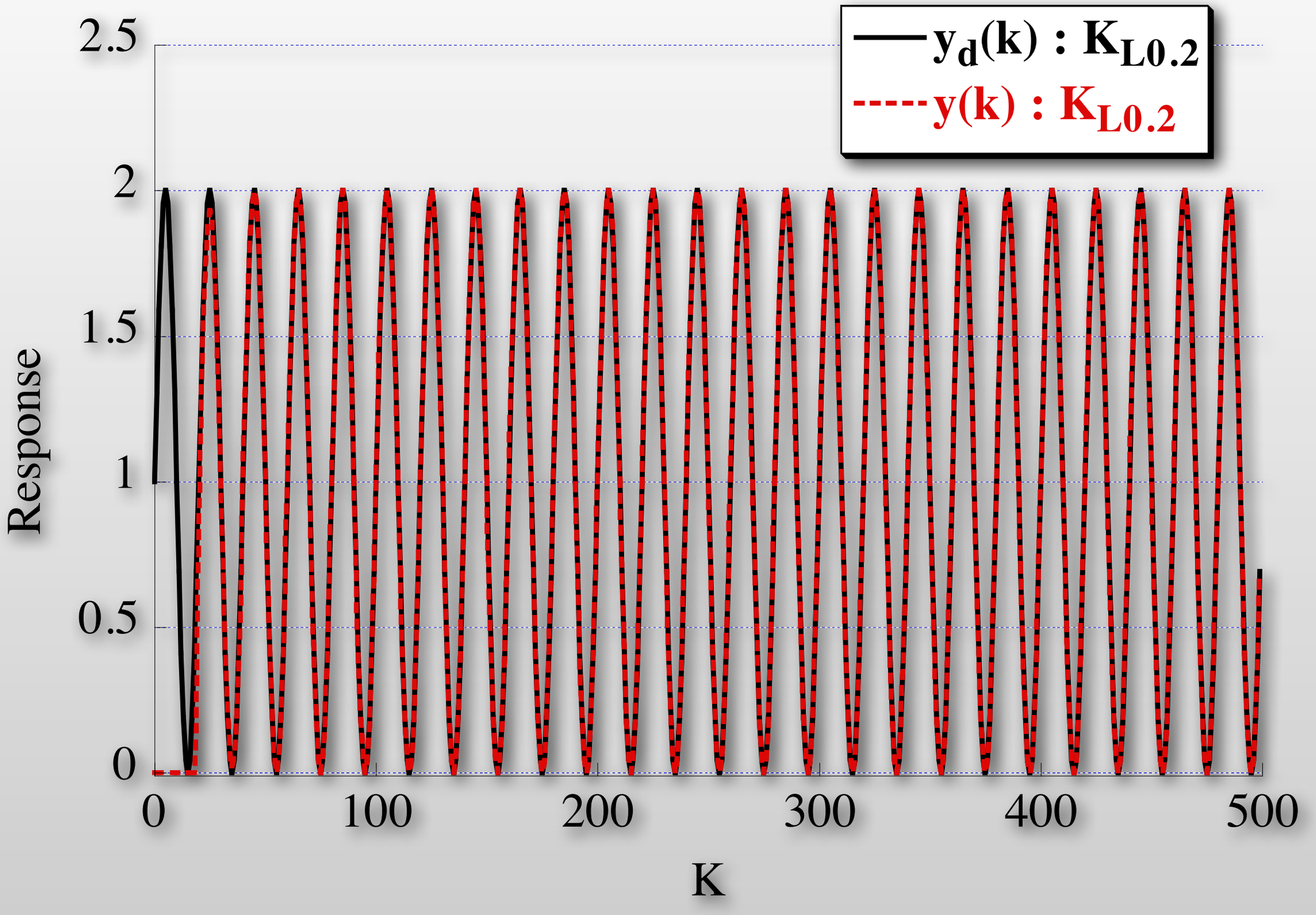
Response For $K_L = 0.05$



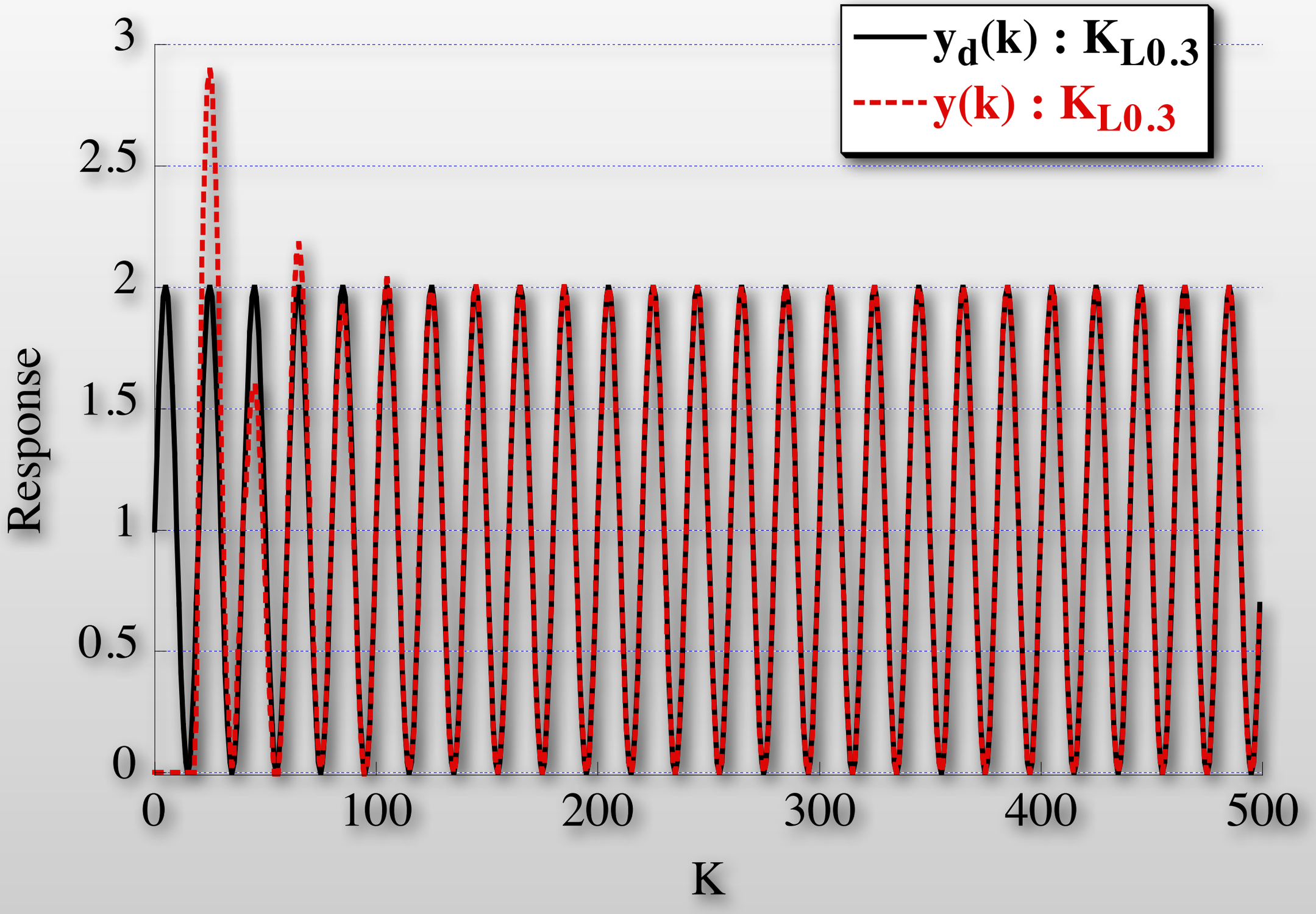
$K_L = 0.1$



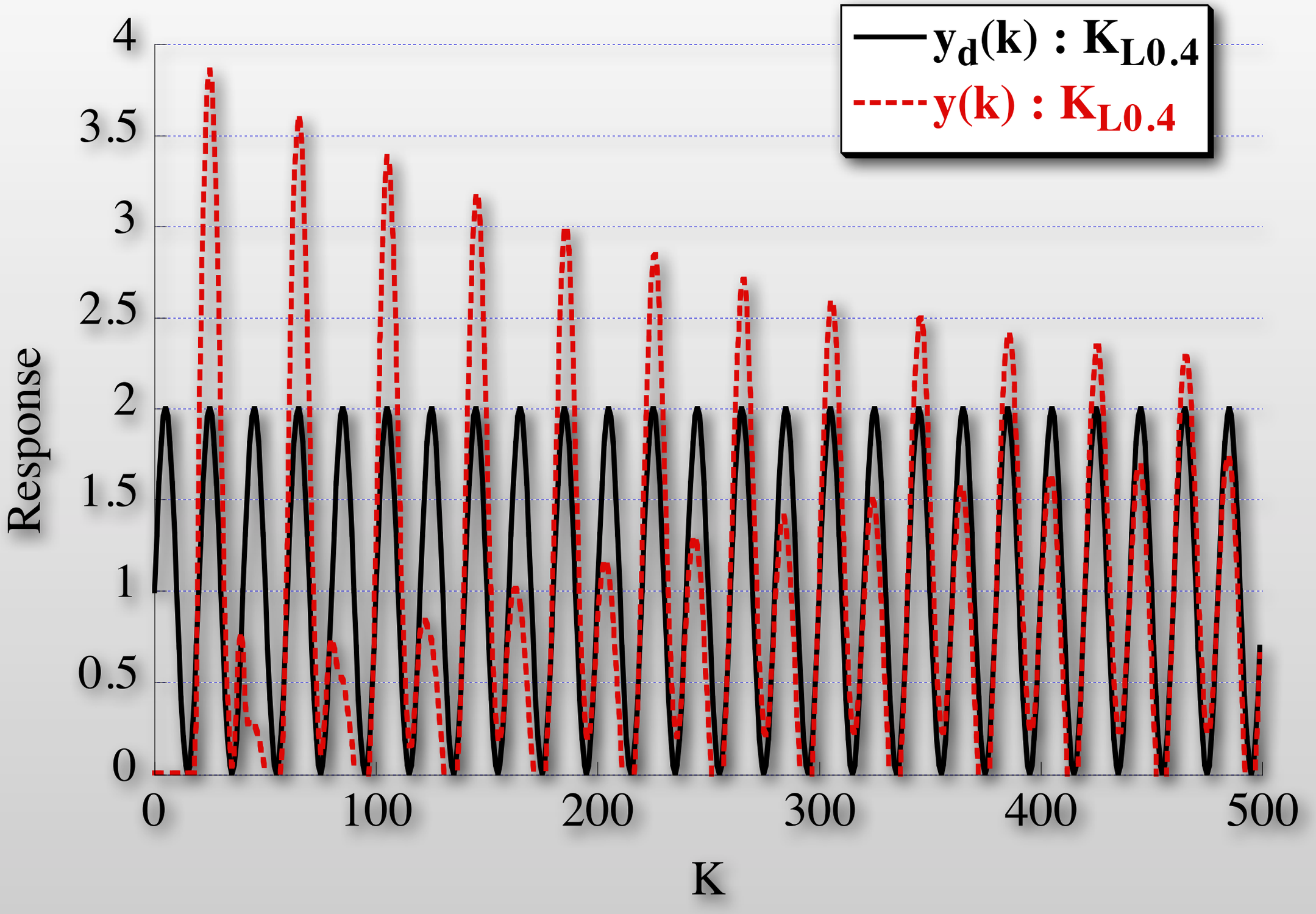
$K_L = 0.2$



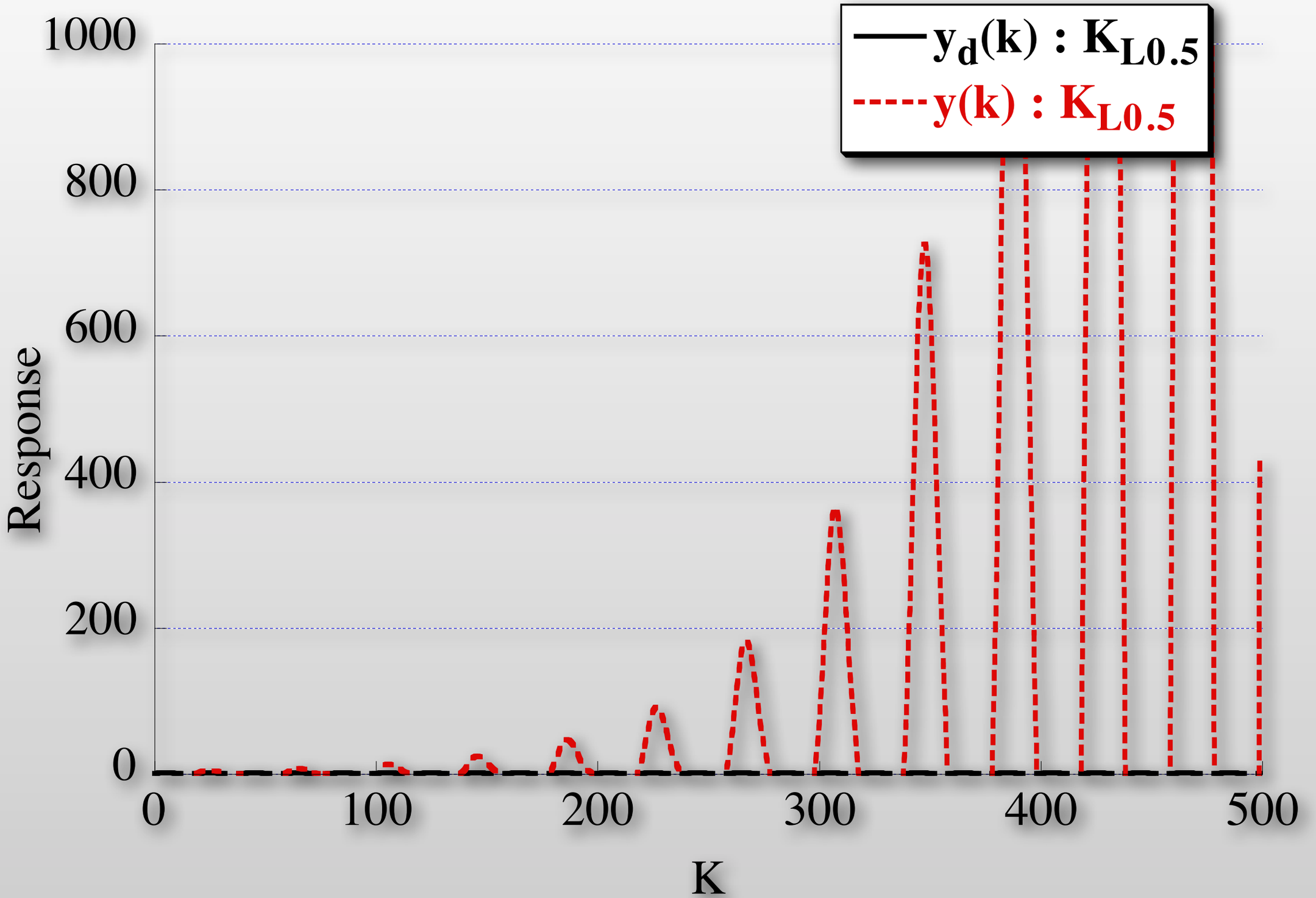
$K_L = 0.3$



$K_L = 0.4$


$y_d(k) : K_{L0.4}$
$y(k) : K_{L0.4}$
Response
4
3.5
3
2.5
2
1.5
1
0.5
0
0
100
200
300
400
500
K

$K_L = 0.5$


$y_d(k) : K_{L0.5}$
$y(k) : K_{L0.5}$
1000
800
600
400
200
0
Response
0
100
200
300
400
500
K

Effect of K_L on Error