# Control Systems HW2

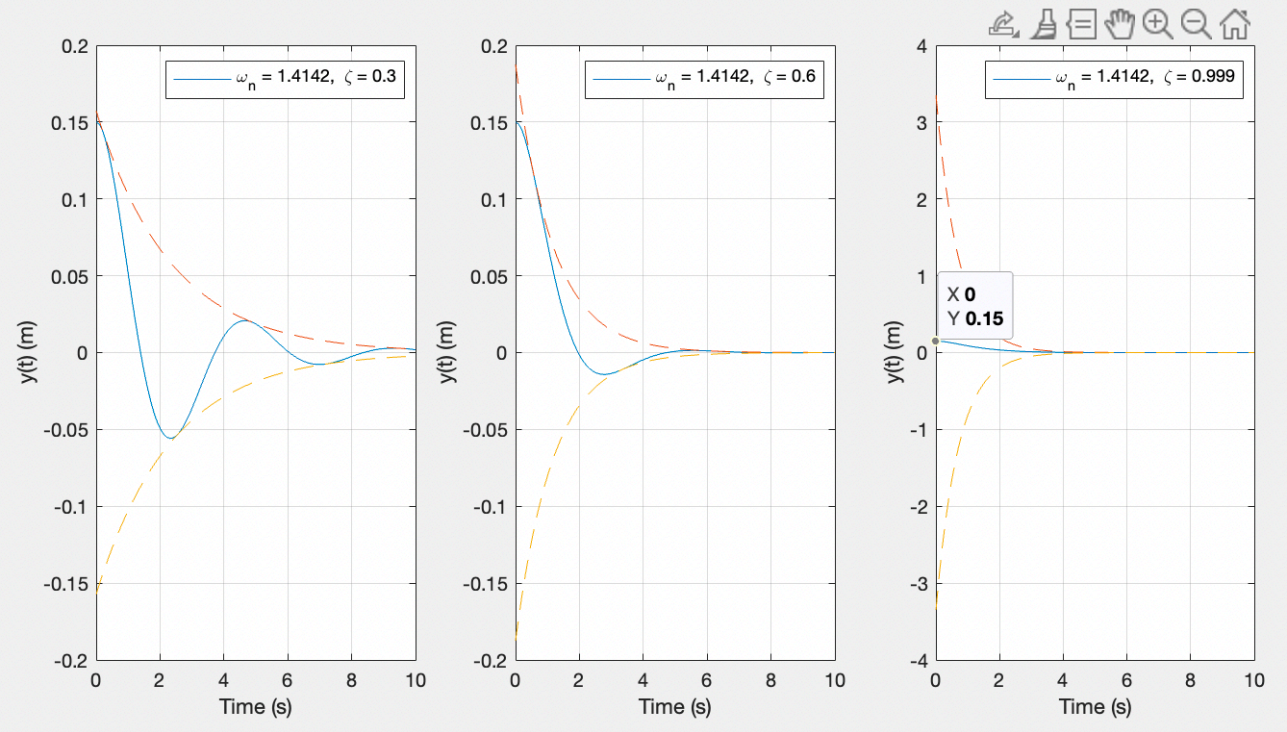
107060011 電資院學士班大三 涂皓鈞

1.

Since the unforced dynamic response $y(t)$ of the spring-mass-damper system gives that

$$y(t) = \frac{y(0)}{\sqrt{1-\zeta^2}} e^{-\zeta\omega_n t} \sin\left(\omega_n \sqrt{1-\zeta^2}\, t + \theta\right),$$

When $\zeta = 1$, $y(t)$ is undefined due to the denominator part of $y(t)$. Thus, I use $\zeta = 0.999 \approx 1$ to simulate. The following shows the result of three specified values of the damping ratio :




$\zeta = 0.3$ $\zeta = 0.6$ $\zeta = 0.999 \approx 1$

2.

The system transfer function :

```
sys =

                s^5 + 4 s^4 + 6 s^3 + 6 s^2 + 5 s + 2
  ------------------------------------------------------------------
  12 s^6 + 205 s^5 + 1066 s^4 + 2517 s^3 + 3128 s^2 + 2196 s + 712
```

The system transfer function after pole-zero cancellation :

```
TransferFunction =

    0.08333 s^4 + 0.25 s^3 + 0.25 s^2 + 0.25 s + 0.1667
  ---------------------------------------------------------
  s^5 + 16.08 s^4 + 72.75 s^3 + 137 s^2 + 123.7 s + 59.33
```

3.

The system transfer function:

```
sys =

          5400
  --------------------
  2 s^2 + 2.5 s + 5402
```

The step response of the system: