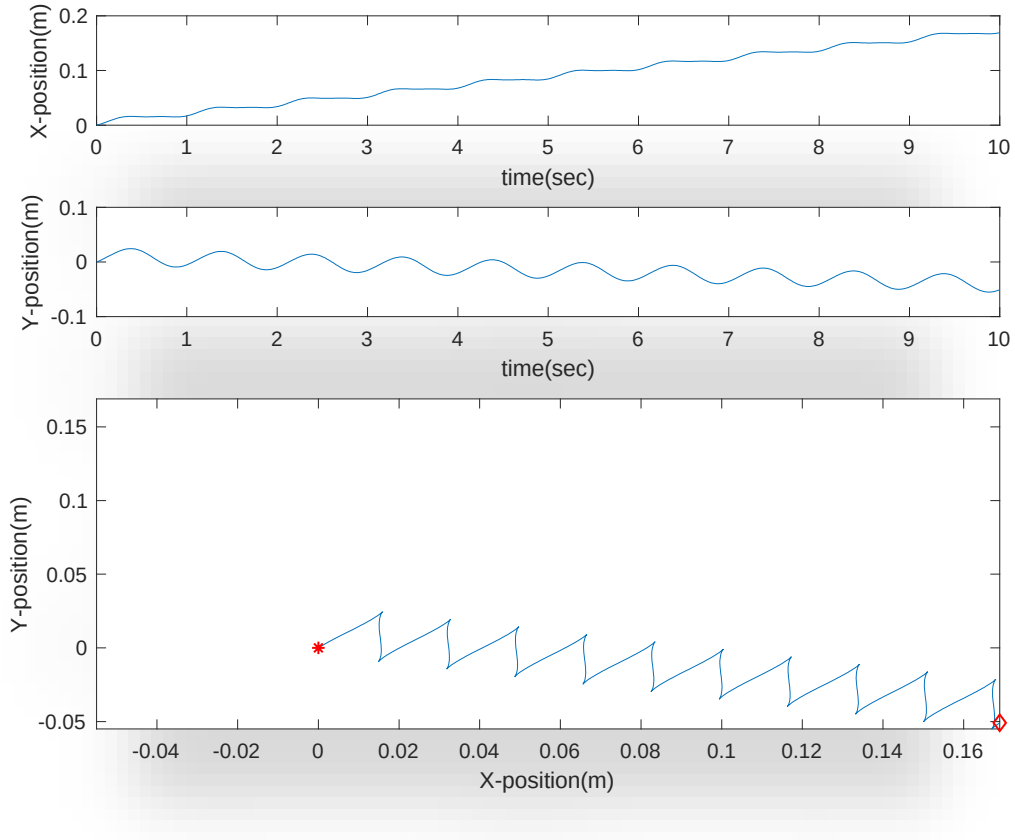
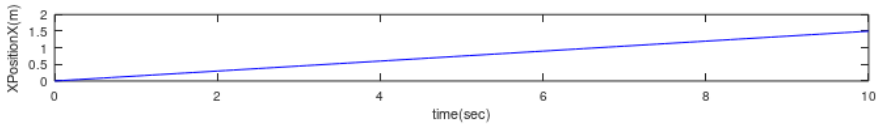
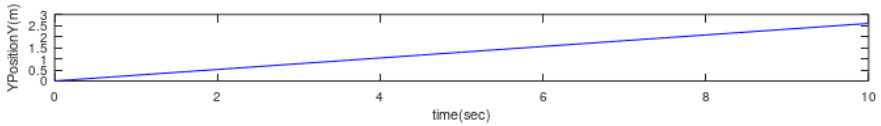
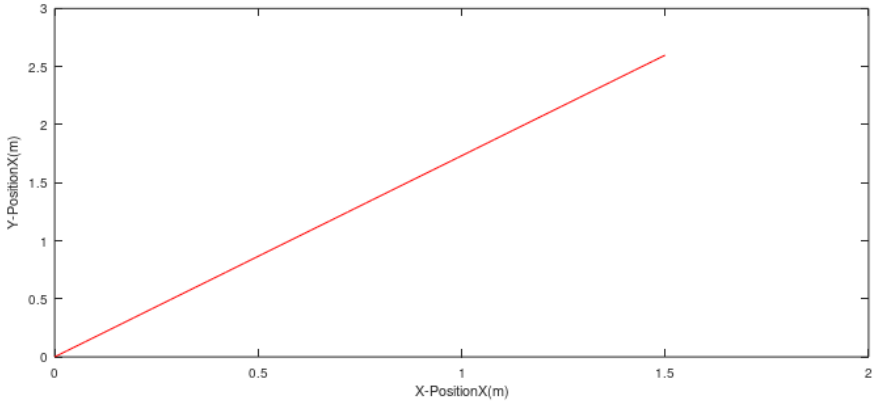
HW01-1

- 請完成以下參數之模擬，模擬圖包含X-T、Y-T、Y-X圖，如右圖
  - $\omega_R = 2, \omega_L = 2,$
  - $\omega_R = 1, \omega_L = 3,$
  - $\omega_R = 3, \omega_L = 2,$
  - $\omega_R = -1, \omega_L = 2$
  - $\omega_R = 20\sin\frac{\pi}{2}t\,, \omega_L = 20cos\frac{\pi}{2}t$
  - $\omega_R = 10\sin 2\pi t\,, \omega_L = 10cos\,2\pi t$
- 最後兩個參數，需附上for迴圈內程式

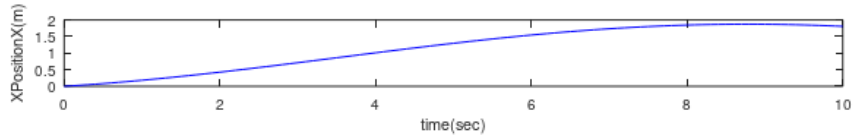


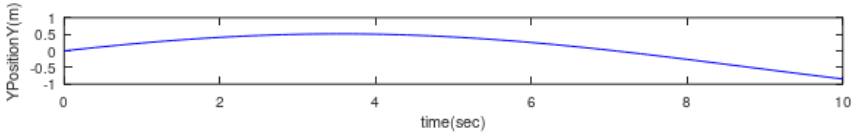


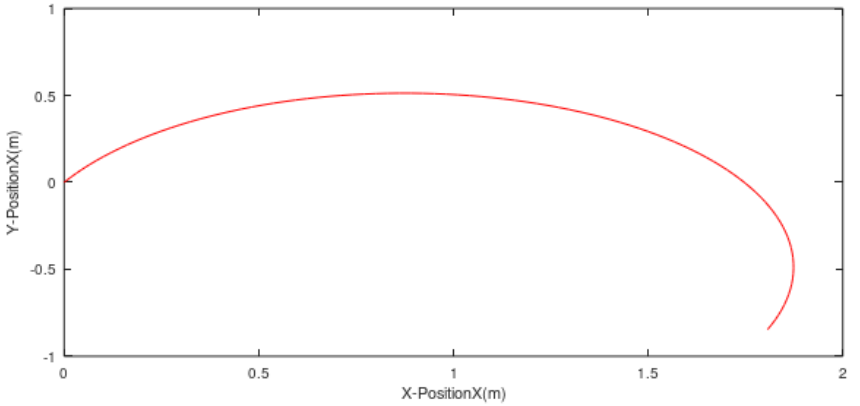




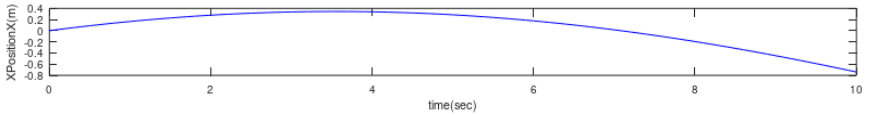
$\omega_R = 2, \omega_L = 2$

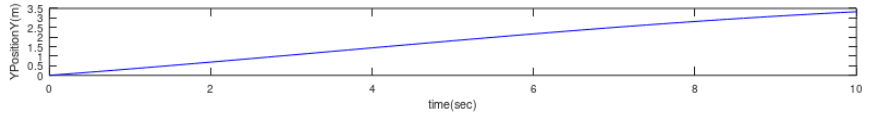


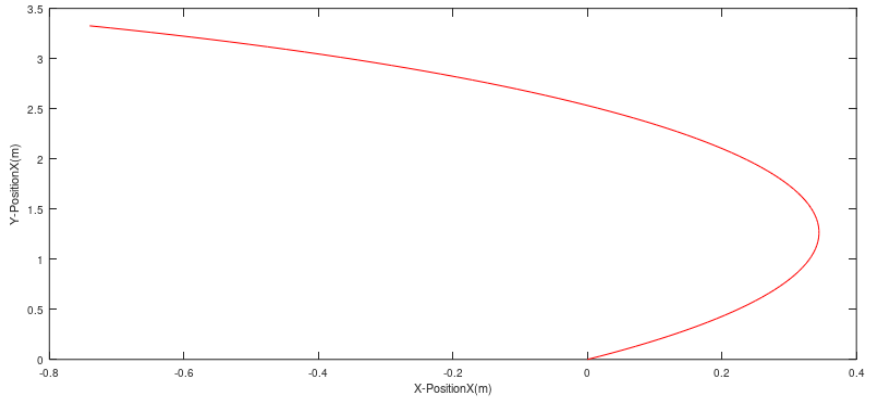




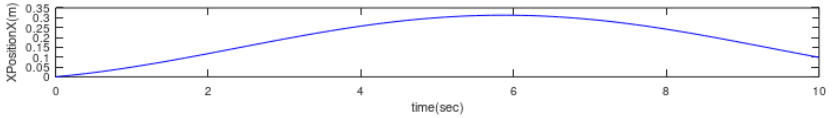
$\omega_R = 1, \omega_L = 3$

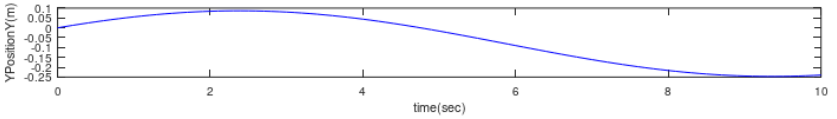


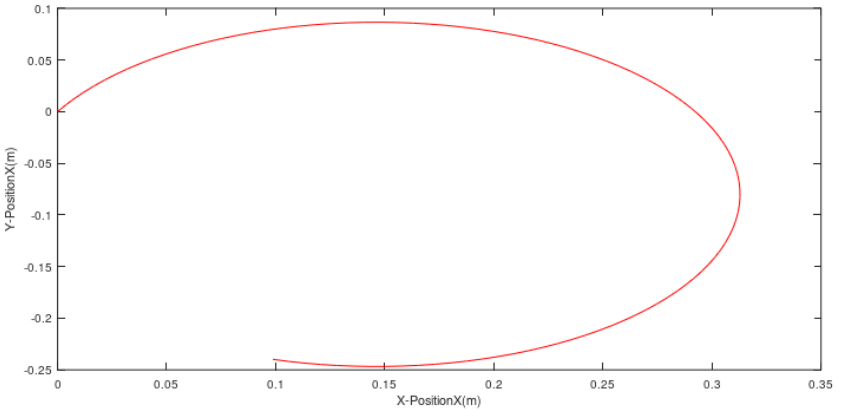




$\omega_R = 3, \omega_L = 2,$

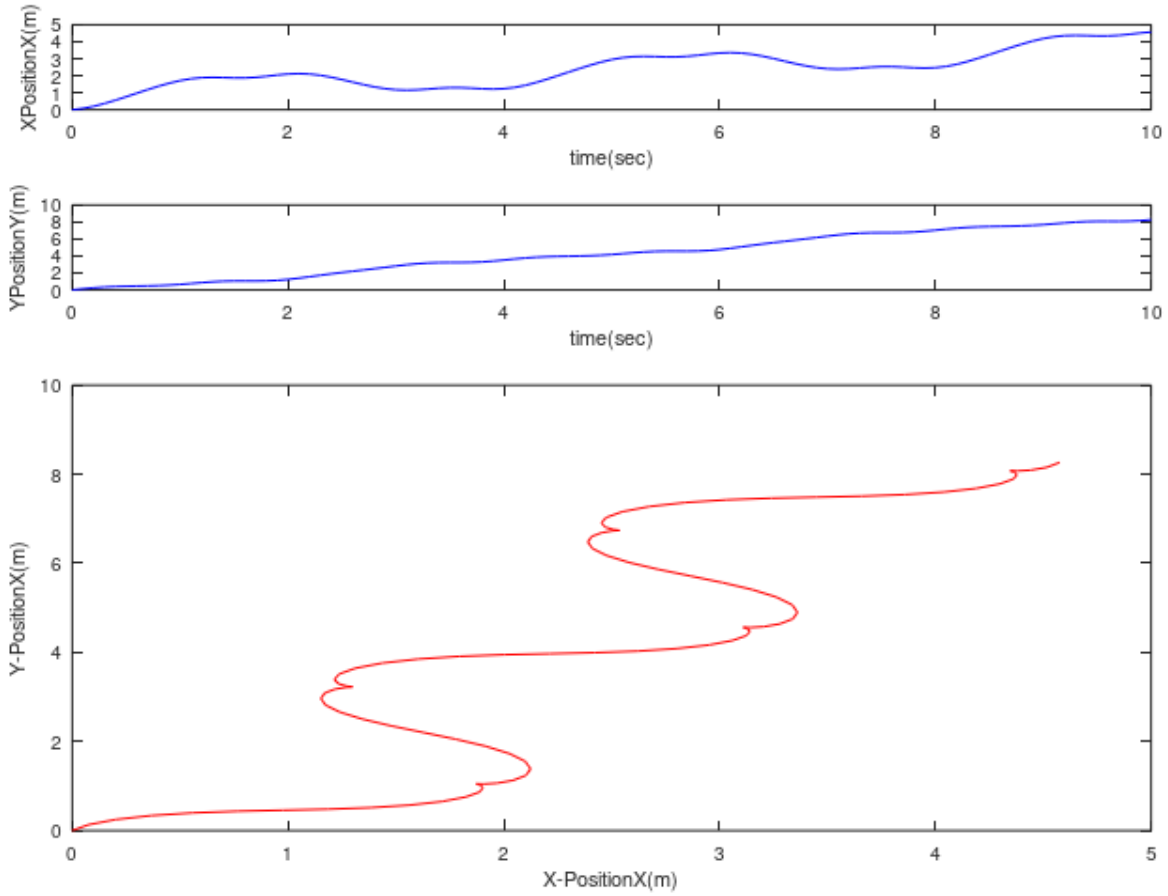






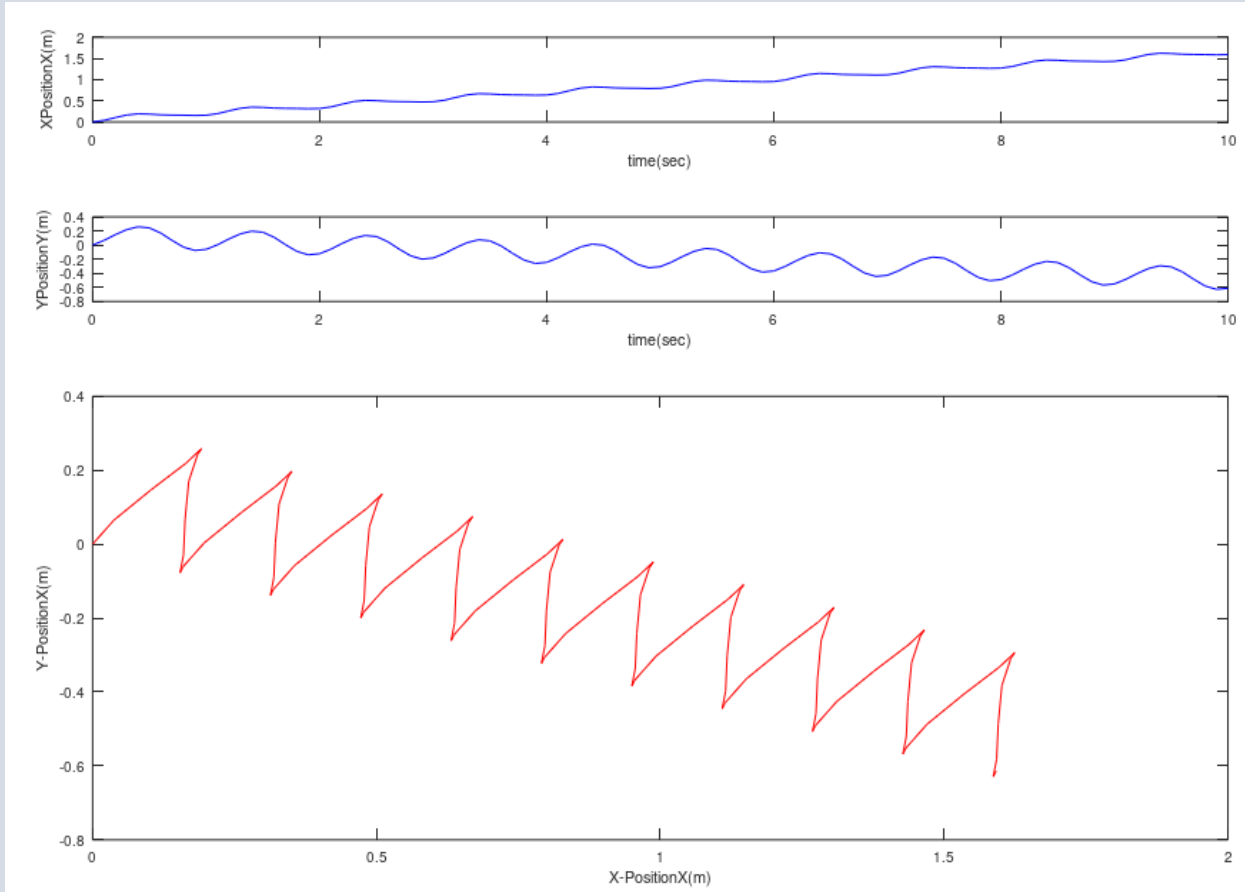
$\omega_R = -1, \omega_L = 2$

$$\omega_R = 20\sin\frac{\pi}{2}t\,,\omega_L = 20cos\frac{\pi}{2}t$$



rightWheel(iter) = 20*sin(pi/2*time);
leftWheel(iter) = 20*cos(pi/2*time);

$$\omega_R = 10\sin 2\pi t\,,\omega_L = 10cos\,2\pi t$$

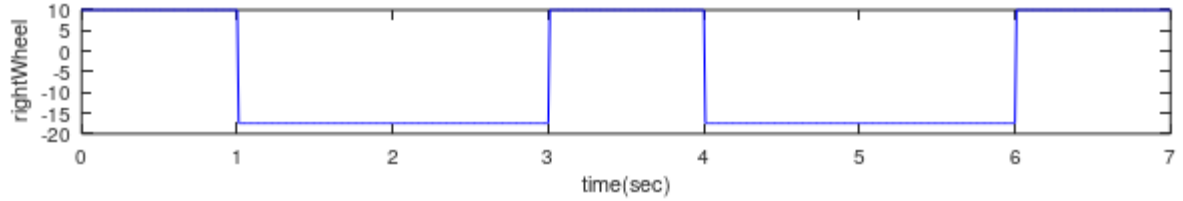


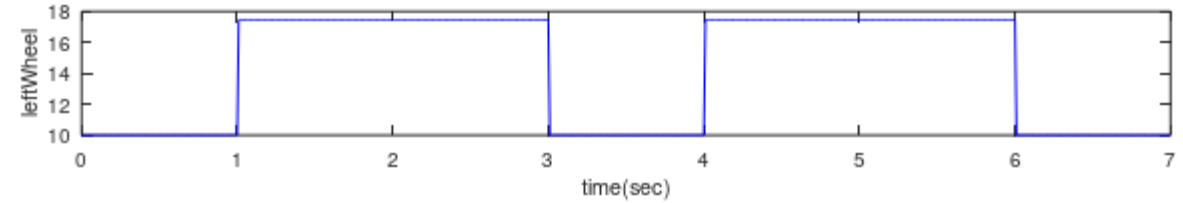
rightWheel(iter) = 10*sin(2*pi*time);
leftWheel(iter) = 10*cos(2*pi*time);

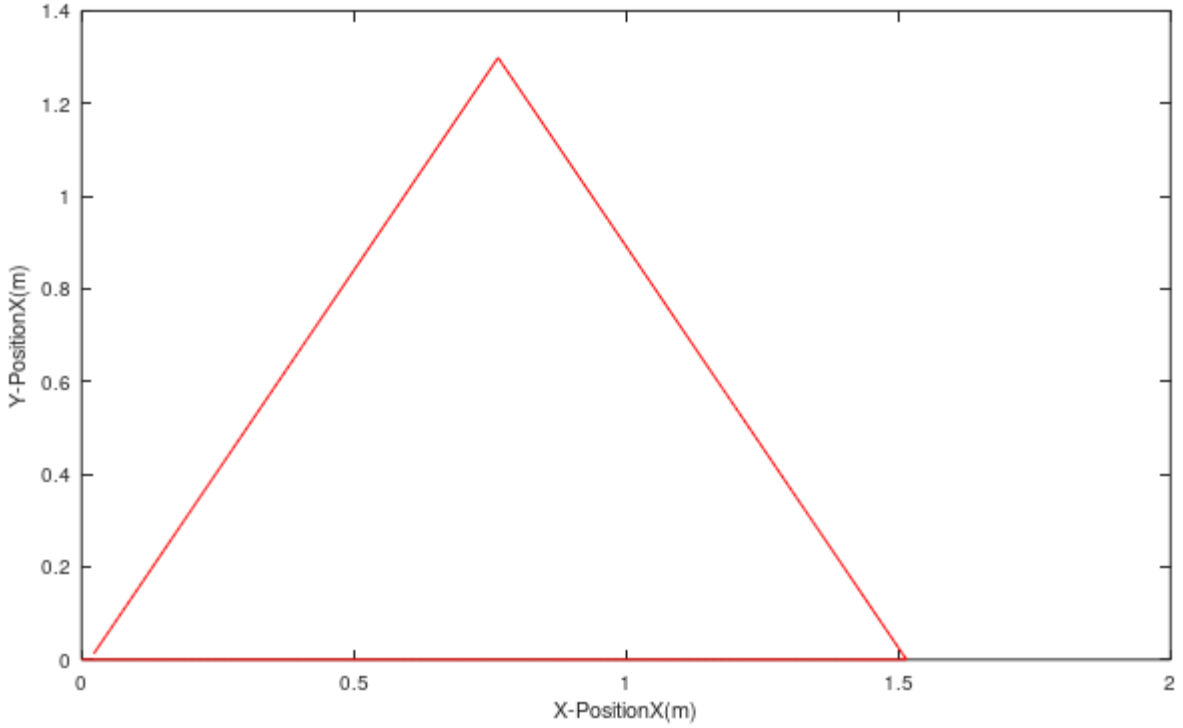
HW01-2

- 請設計兩輪轉速使得機器人的行徑軌跡如下
  - 三角形
  - 矩形
- 需附上for迴圈內程式
- 請繪出ω_R -T、 ω_L -T、Y-X圖

三角形



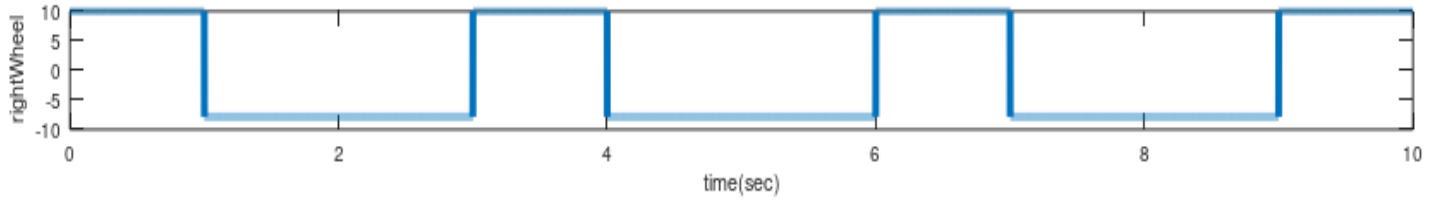


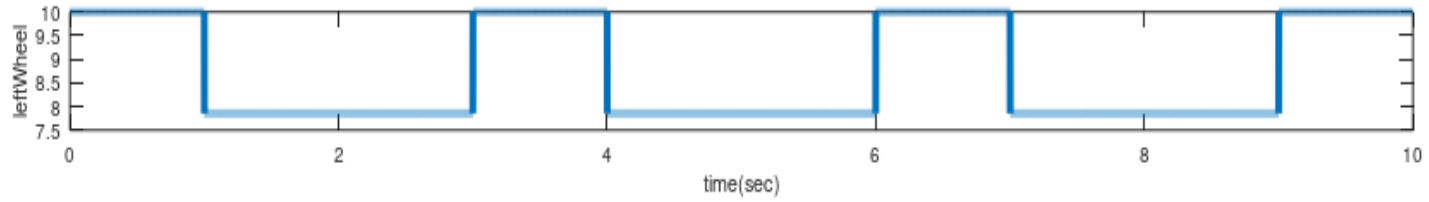


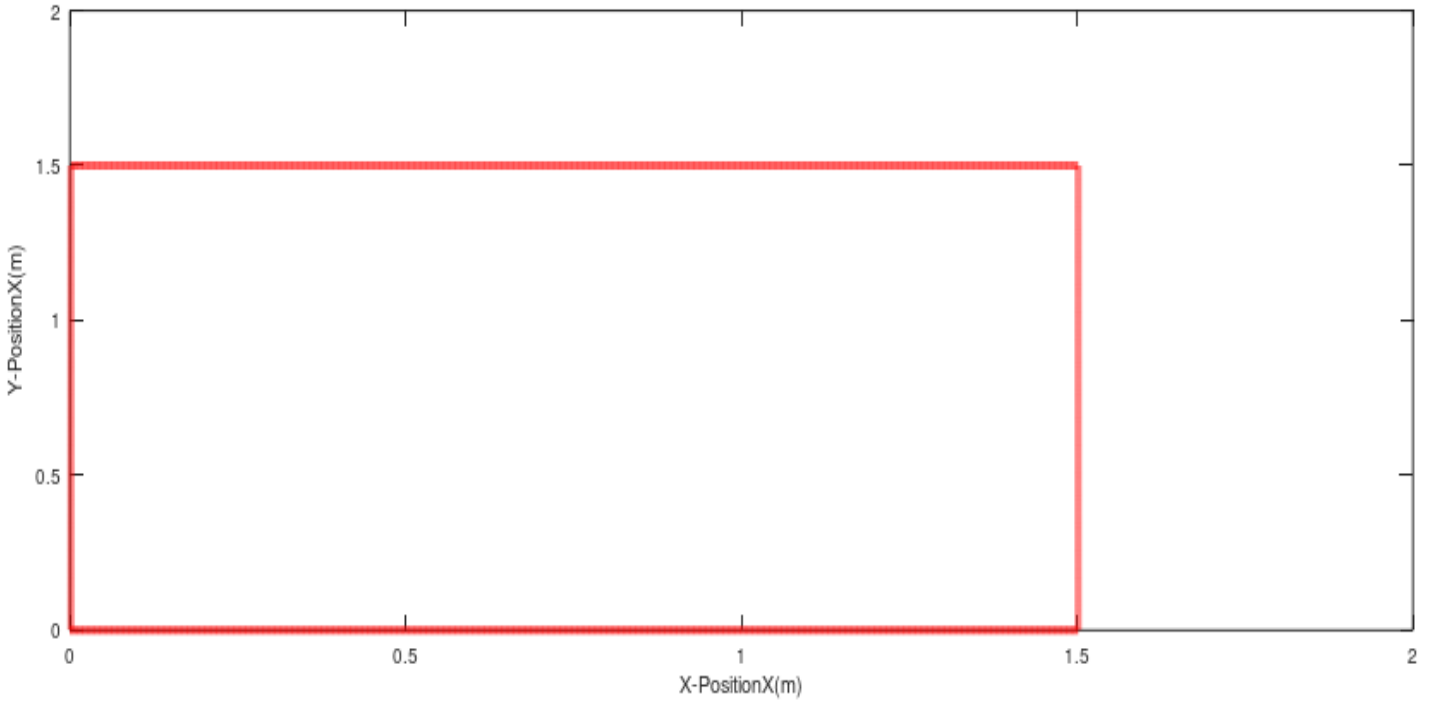

```
for time=time_start:time_sampling:time_end
 iter += 1;

 if time <= 1
  rightWheel(iter) = 10;
  leftWheel (iter) = 10;
 elseif time <= 3
  rightWheel(iter) =  10*-100*pi/180;
  leftWheel (iter) =  10* 100*pi/180;
 elseif time <= 4
  rightWheel(iter) =  10;
  leftWheel (iter) =  10;
 elseif time <= 6
  rightWheel(iter) =  10*-100*pi/180;
  leftWheel (iter) =  10* 100*pi/180;
 elseif time <= 7
  rightWheel(iter) =  10;
  leftWheel (iter) =  10;
 endif
```

矩形








```
for time=time_start:time_sampling:time_end
 iter += 1;

 if time <= 1
  rightWheel(iter) = 10;
  leftWheel (iter) = 10;
 elseif time <= 3
  rightWheel(iter) =  10*-45*pi/180;
  leftWheel (iter) =  10* 45*pi/180;
 elseif time <= 4
  rightWheel(iter) =  10;
  leftWheel (iter) =  10;
 elseif time <= 6
  rightWheel(iter) =  10*-45*pi/180;
  leftWheel (iter) =  10* 45*pi/180;
 elseif time <= 7
  rightWheel(iter) =  10;
  leftWheel (iter) =  10;
 elseif time <= 9
  rightWheel(iter) =  10*-45*pi/180;
  leftWheel (iter) =  10* 45*pi/180;
 else
  rightWheel(iter) =  10;
  leftWheel (iter) =  10;
 endif
```

HW02-1

- 輪型機器人之輪軸距離為10cm，輪子半徑為3cm。
  - 機器人起始位置(2,2)，起始角度90°
    - $t = 0\sim1$，角度轉動$-60°$
    - $t = 1\sim6$，移動$1m$
    - $t = 6\sim8$，角度轉動$-120°$
- 請計算出各時間區間之左右輪轉速
- 請繪出左右輪對時間之響應圖(合併於同一畫布中)、角度對時間響應圖、X-Y座標響應圖
- 模擬圖說明
- 程式碼以及其註解

EX. 機器人起始位置(2,2)，起始角度90°

- $t = 0\sim1$，角度轉動$-60°$
- $t = 1\sim6$，移動$1m$
- $t = 6\sim8$，角度轉動$-120°$

求機器人停在哪個位置以及面向哪個角度 (L=0.1, r=0.03)

請計算出各時間區間之左右輪轉速

$$\omega_B(t = 0\sim1) = \frac{-60° * \frac{\pi}{180°}}{1-0} = \frac{r(\omega_R(t_{0-1}) - \omega_L(t_{0-1}))}{L}$$

$$\omega_R(t_{0-1}) - \omega_L(t_{0-1}) = \frac{-60 * 0.1}{0.03} = -200 \quad \text{and} \quad R_w = 0$$

$$\omega_R(t_{0-1}) = -100 * \frac{\pi}{180}$$

$$\omega_L(t_{0-1}) = 100 * \frac{\pi}{180}$$

$$V_B(t = 1\sim6) = \frac{1}{6-1} = \frac{r(\omega_R(t_{1-6}) + \omega_L(t_{1-6}))}{2}$$

$$\omega_R(t_{1-6}) + \omega_L(t_{1-6}) = \frac{2/0.03}{5} = 13.33 \quad \text{and} \quad R_w \to \infty$$

$$\omega_R(t_{1-6}) = 6.67$$

$$\omega_L(t_{1-6}) = 6.67$$

$$\omega_B(t = 6\sim8) = \frac{-120° * \frac{\pi}{180°}}{8-6} = \frac{r(\omega_R(t_{6-8}) - \omega_L(t_{6-8}))}{L}$$

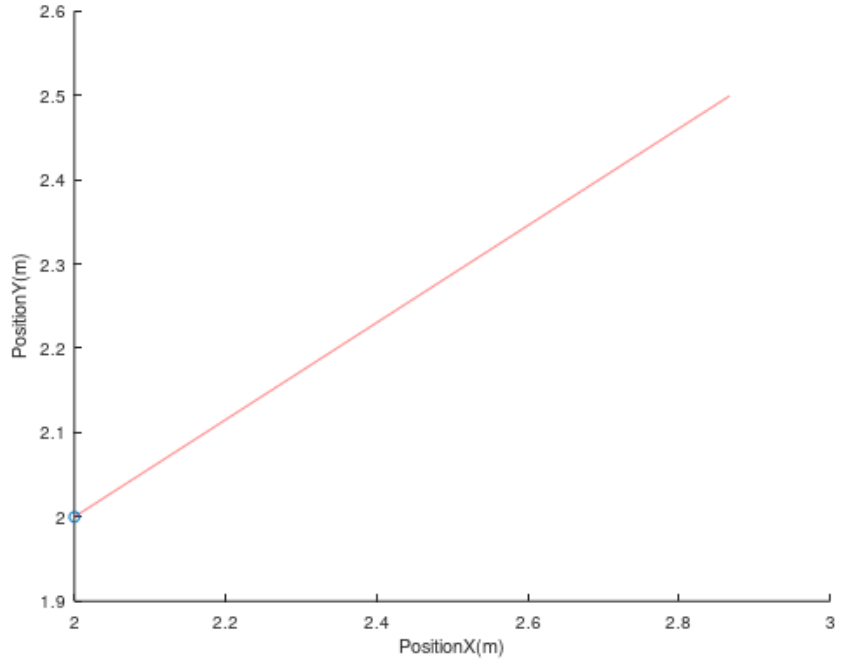
$$\omega_R(t_{6-8}) - \omega_L(t_{6-8}) = \frac{-120 * 0.1}{2 * 0.03} = -200 \quad \text{and} \quad R_w = 0$$

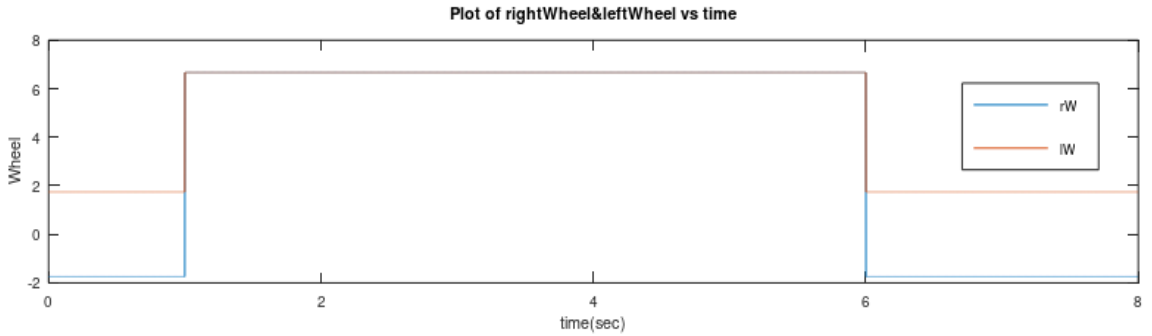
$$\omega_R(t_{6-8}) = -100 * \frac{\pi}{180}$$

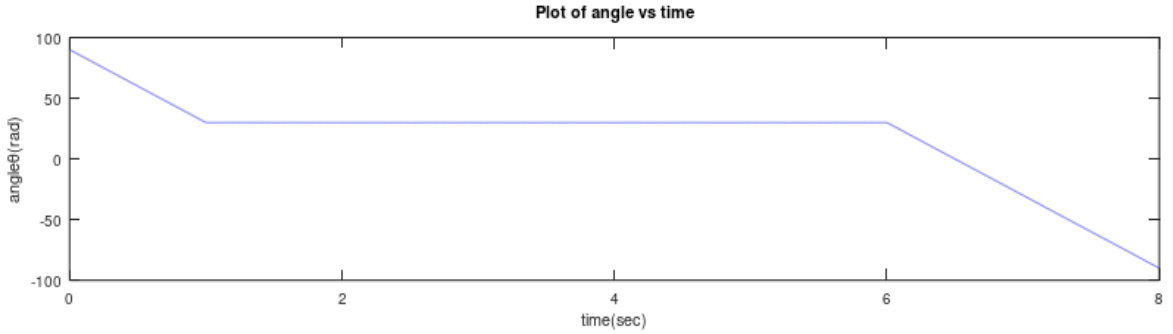
$$\omega_L(t_{6-8}) = 100 * \frac{\pi}{180}$$

- 請繪出左右輪對時間之響應圖(合併於同一畫布中)、
- 角度對時間響應圖、X-Y座標響應圖

```
if time <= 1
  Wheel = fun_robotRotation(1, -pi/3, 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 6
  Wheel = fun_robotStraight(5,1);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <=8
  Wheel = fun_robotRotation(2, -pi*(2/3), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
else
  Wheel = [0 0];
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
endif
```

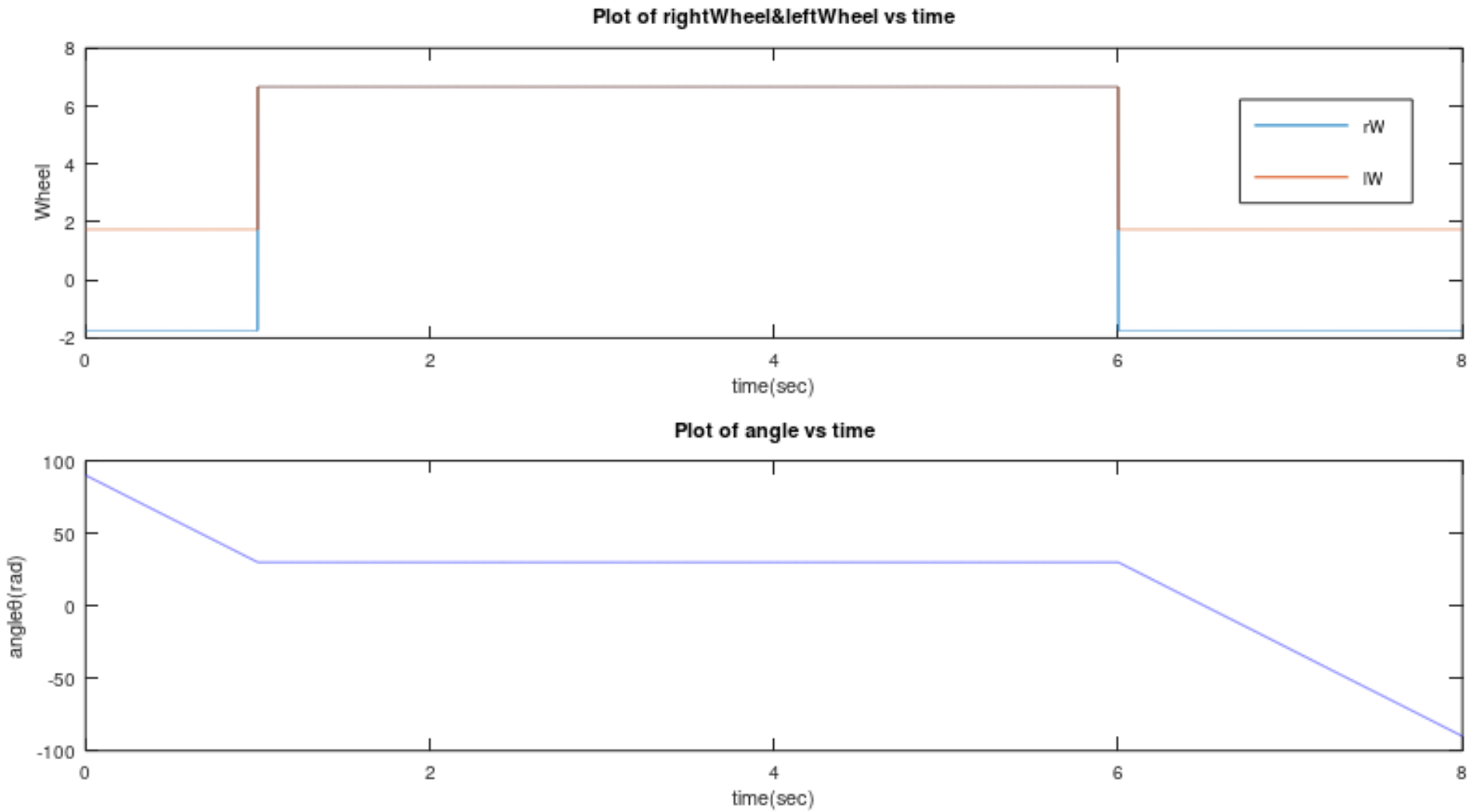






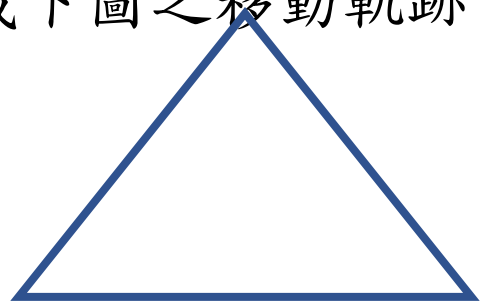
- 模擬圖說明

0~1秒旋轉-60　　1~6秒前進6.67　　6~8秒旋轉-120



HW02-2

- 輪型機器人之輪軸距離為10cm，輪子半徑為3cm，左右輪最大轉速為120rpm。
  - 機器人（每邊長3m）
  - 起始位置(2,2)，起始角度90°
  - 請完成下圖之移動軌跡



- 請計算出各時間區間之左右輪轉速
- 請繪出左右輪對時間之響應圖(合併於同一畫布中)、角度對時間響應圖、X-Y座標響應圖
- 模擬圖說明
- 程式碼以及其註解

請計算出各時間區間之左右輪轉速
輪軸距離為10cm，輪子半徑為3cm，左右輪最大轉速為120rpm。

EX. 機器人起始位置(2,2)，起始角度90°
- $t = 0\sim2$，角度轉動$-30°$
- $t = 2\sim10$，移動3m
- $t = 10\sim14$，角度轉動$-120°$
- $t = 14\sim22$，移動3m
- $t = 22\sim26$，角度轉動$-120°$
- $t = 26\sim34$，移動3m

$$\omega_B(t = 0\sim2) = \frac{-30° * \frac{\pi}{180°}}{2 - 0} = \frac{r(\omega_R(t_{0-2}) - \omega_L(t_{0-2}))}{L}$$

$$\omega_R(t_{0-2}) - \omega_L(t_{0-2}) = \frac{-30*0.1}{2*0.03} = -50$$

$$\omega_R(t_{0-2}) = -25 * \frac{\pi}{180}$$
$$\omega_L(t_{0-2}) = 25 * \frac{\pi}{180}$$

$$V_B(t = 2\sim10) = \frac{3}{10 - 2} = \frac{r(\omega_R(t_{2-10}) + \omega_L(t_{2-10}))}{2}$$

$$\omega_R(t_{2-10}) + \omega_L(t_{2-10}) = \frac{3}{8} * \frac{2}{r=0.03} = 25$$

$$\omega_R(t_{2-10}) = 12.5$$
$$\omega_L(t_{2-10}) = 12.5$$

$$\omega_B(t = 10\sim14) = \frac{-120° * \frac{\pi}{180°}}{14 - 10} = \frac{r(\omega_R(t_{10-14}) - \omega_L(t_{10-14}))}{L}$$

$$\omega_R(t_{10-14}) - \omega_L(t_{10-14}) = \frac{-120}{4} * \frac{L=0.1}{r=0.03} = 100$$

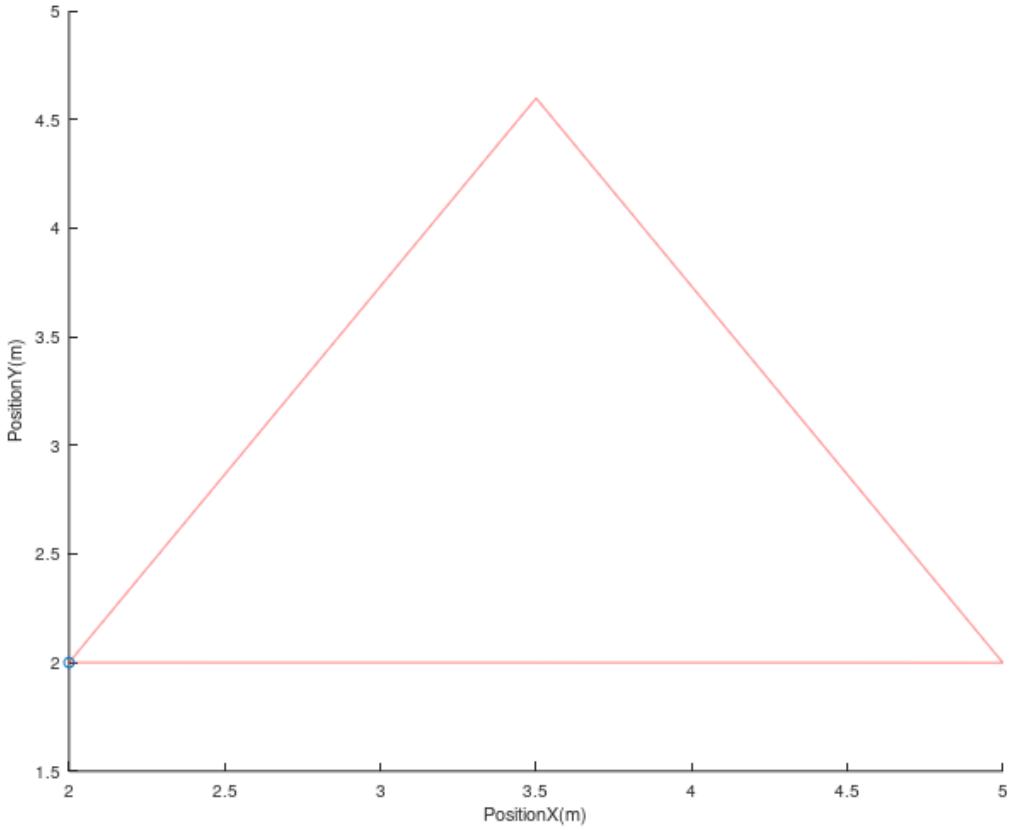
$$\omega_R(t_{10-14}) = 50 * \frac{\pi}{180}$$
$$\omega_L(t_{10-14}) = \text{-}50 * \frac{\pi}{180}$$

$$\omega_R(t_{14-22}) = 12.5$$
$$\omega_L(t_{14-22}) = 12.5$$

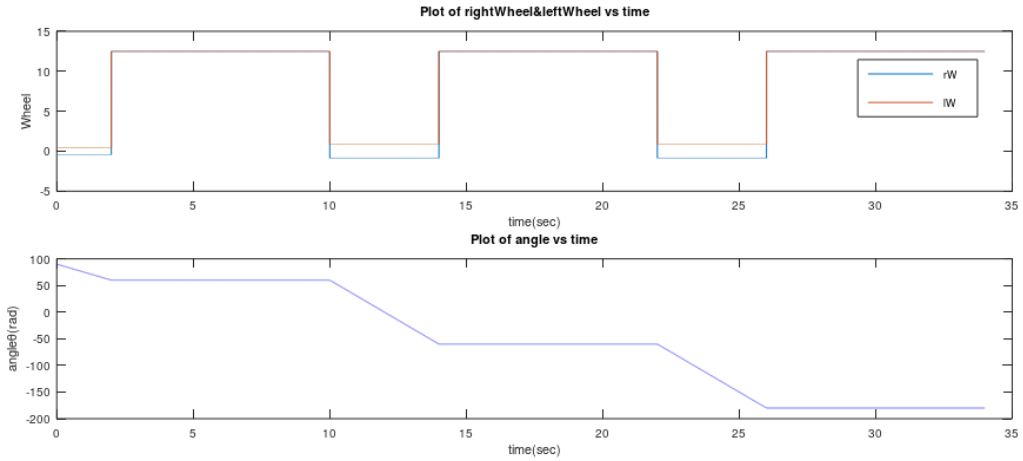
$$\omega_R(t_{22-26}) = 50 * \frac{\pi}{180}$$
$$\omega_L(t_{22-26}) = \text{-}50 * \frac{\pi}{180}$$

$$\omega_R(t_{26-34}) = 12.5$$
$$\omega_L(t_{26-34}) = 12.5$$

```
if time <= 2
  Wheel = fun_robotRotation(2, -pi/6, 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 10
  Wheel = fun_robotStraight(8,3);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <=14
  Wheel = fun_robotRotation(4, -pi*(2/3), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 22
  Wheel = fun_robotStraight(8,3);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <=26
  Wheel = fun_robotRotation(4, -pi*(2/3), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 34
  Wheel = fun_robotStraight(8,3);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
else
  Wheel = [0 0];
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
endif
```



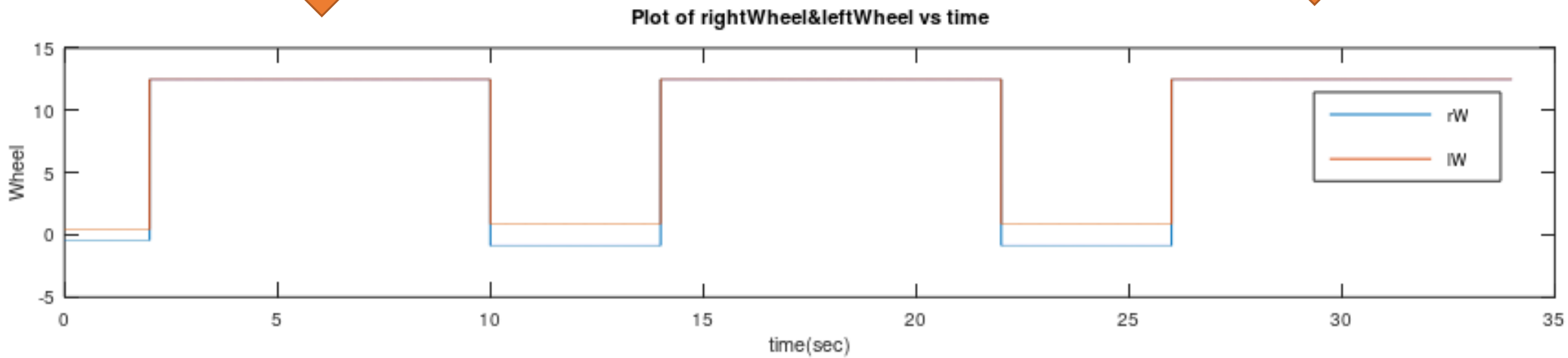

```
>> max(rightWheel)
ans =  12.500
>> max(leftWheel)
ans =  12.500
>> max(leftWheel)*60/2/pi
ans =  119.37 < 120
```

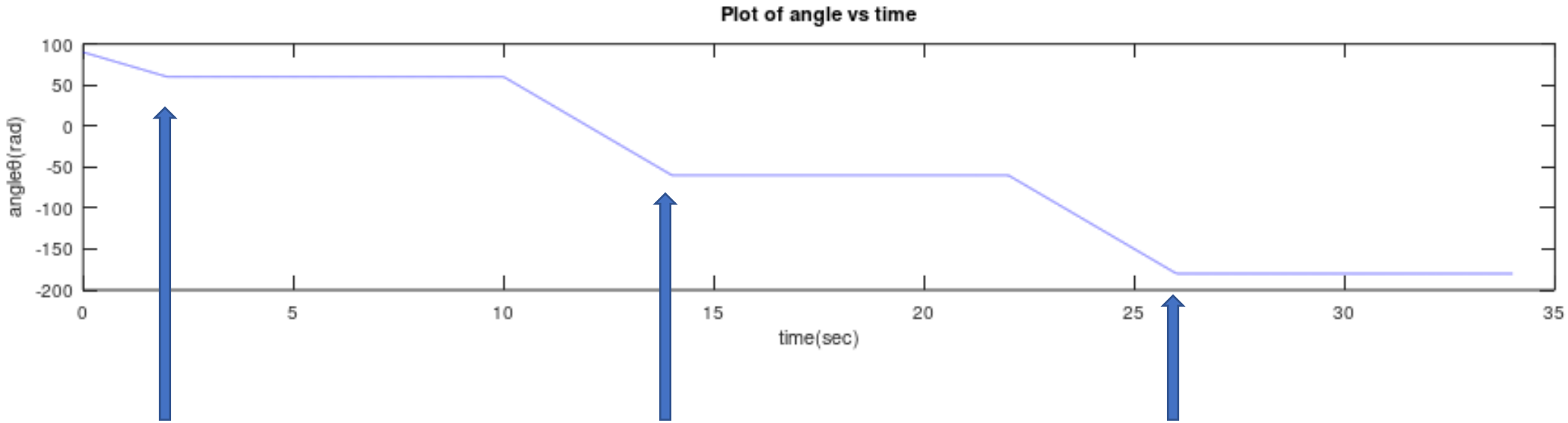


請繪出左右輪對時間之響應圖(合併於同一畫布中)、角度對時間響應圖、X-Y座標響應圖

模擬圖說明

左輪與右輪轉速 12.5m





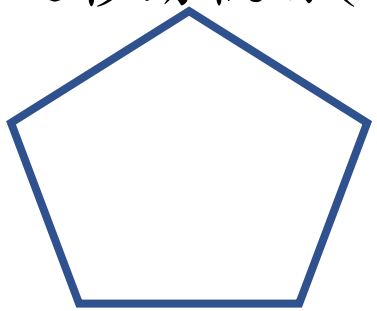
0秒~1秒，由90 °順時針轉30 °變成60 °

10秒~14秒，由60 °順時針轉120 °變成-60 °

22秒~26秒，由-60 °順時針轉120 °變成-180 °

HW02-3

- 輪型機器人之輪軸距離為10cm，輪子半徑為3cm，左右輪最大轉速為120rpm。
  - 機器人起始位置(2,2)，起始角度90°
  - 請完成下圖之移動軌跡(每邊長2m)



- 請計算出各時間區間之左右輪轉速
- 請繪出左右輪對時間之響應圖(合併於同一畫布中)、角度對時間響應圖、X-Y座標響應圖
- 模擬圖說明
- 程式碼以及其註解

EX. 機器人起始位置(2,2)，起始角度90°

- $t = 0\sim1$，角度轉動18°
- $t = 1\sim7$，移動2m
- $t = 7\sim9$，角度轉動−72°
- $t = 9\sim15$，移動2m
- $t = 15\sim17$，角度轉動−72°
- $t = 17\sim23$，移動2m
- $t = 23\sim25$，角度轉動−72°
- $t = 25\sim31$，移動2m
- $t = 31\sim33$，角度轉動−72°
- $t = 33\sim39$，移動2m

請計算出各時間區間之左右輪轉速

$$\omega_B(t = 0\sim1) = \frac{18° * \frac{\pi}{180°}}{1 - 0} = \frac{r(\omega_R(t_{0-1}) - \omega_L(t_{0-1}))}{L}$$

$$\omega_R(t_{0-1}) - \omega_L(t_{0-1}) = \frac{18}{1} * \frac{0.1}{0.03} = +60$$

$$\omega_R(t_{0-1}) = +30 * \frac{\pi}{180}$$

$$\omega_L(t_{0-1}) = -30 * \frac{\pi}{180}$$

$$V_B(t = 1\sim7) = \frac{2}{7 - 1} = \frac{r(\omega_R(t_{1-7}) + \omega_L(t_{1-7}))}{2}$$

$$\omega_R(t_{1-7}) + \omega_L(t_{1-7}) = \frac{2}{6} * \frac{2}{r = 0.03} = 22.22$$

$$\omega_R(t_{1-7}) = 11.11$$

$$\omega_L(t_{1-7}) = 11.11$$

$$\omega_B(t = 7\sim9) = \frac{-72° * \frac{\pi}{180°}}{9 - 7} = \frac{r(\omega_R(t_{7-9}) - \omega_L(t_{7-9}))}{L}$$

$$\omega_R(t_{7-9}) - \omega_L(t_{7-9}) = \frac{-72}{2} * \frac{L = 0.1}{r = 0.03} = -120$$

$$\omega_R(t_{7-9}) = -60 * \frac{\pi}{180}$$

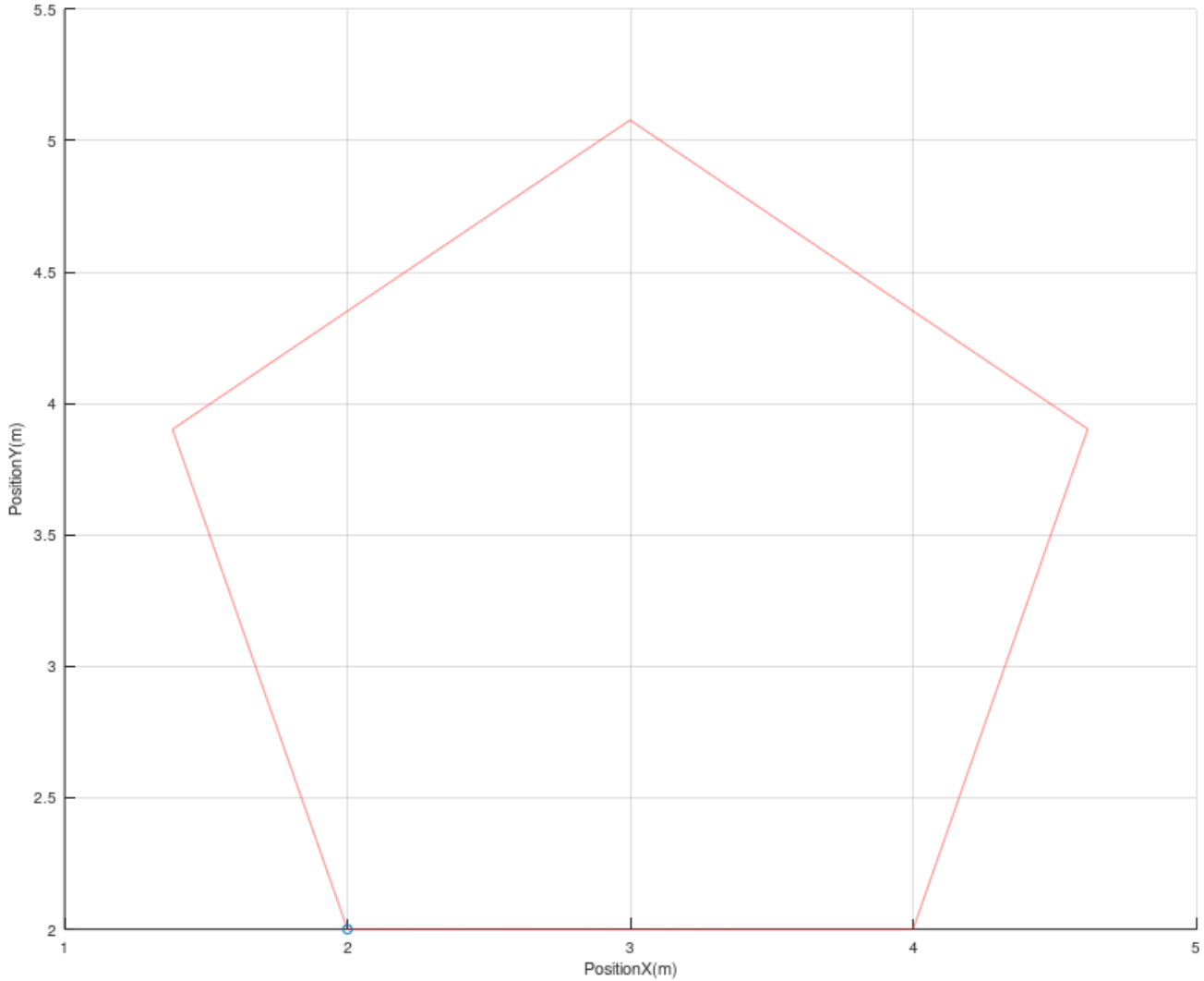
$$\omega_L(t_{7-9}) = 60 * \frac{\pi}{180}$$

$$\omega_R(t_{9-15}) = 11.11$$

$$\omega_L(t_{9-15}) = 11.11$$

. . . 重複

```
if time <= 1
  Wheel = fun_robotRotation(1, pi*(18/180), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 7
  Wheel = fun_robotStraight(6,2);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <=9
  Wheel = fun_robotRotation(2, -pi*(72/180), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 15
  Wheel = fun_robotStraight(6,2);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <=17
  Wheel = fun_robotRotation(2, -pi*(72/180), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 23
  Wheel = fun_robotStraight(6,2);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <=25
  Wheel = fun_robotRotation(2, -pi*(72/180), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 31
  Wheel = fun_robotStraight(6,2);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <=33
  Wheel = fun_robotRotation(2, -pi*(72/180), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 39
  Wheel = fun_robotStraight(6,2);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
else
  Wheel = [0 0];
  rightWheel(iter) = Wheel(1);
```

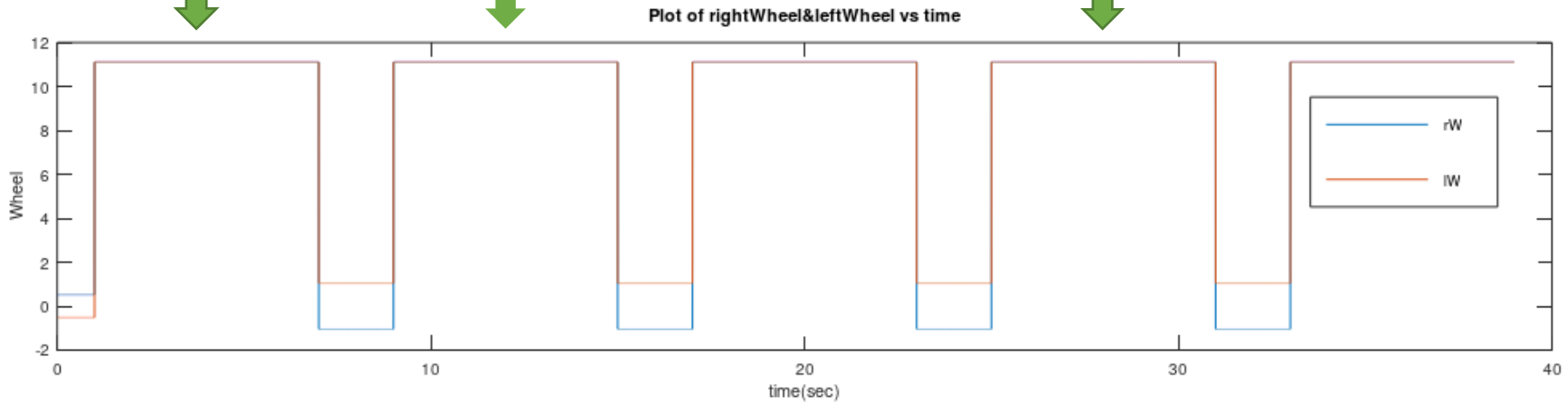


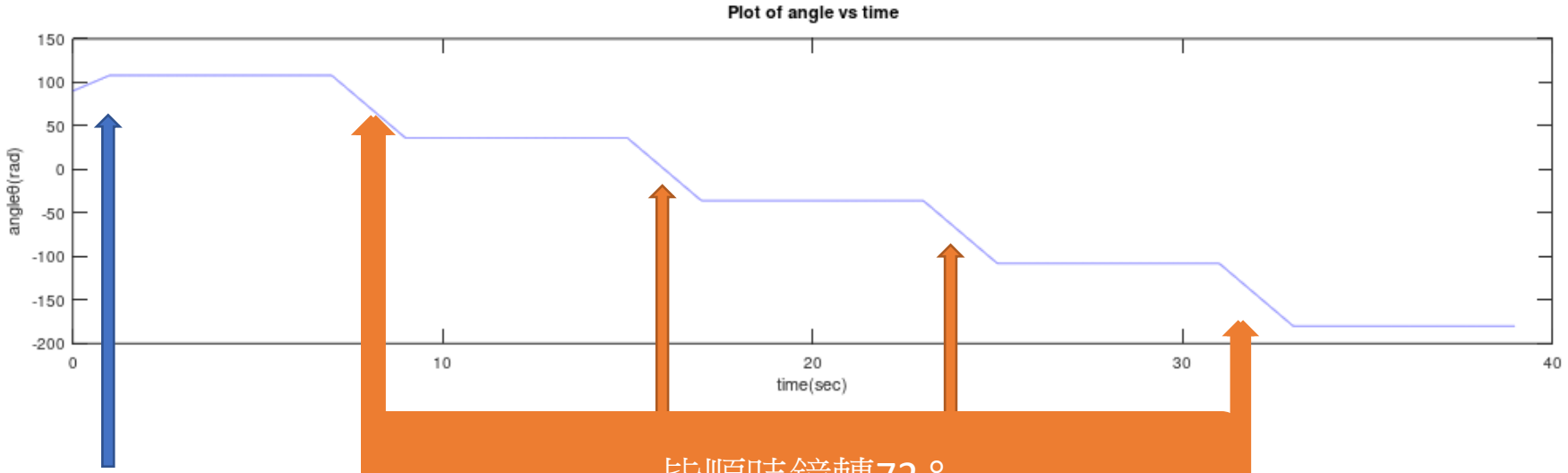
X-Y座標響應圖

```
>> max(rightWheel)
ans =  11.111
>> max(leftWheel)
ans =  11.111
>> max(leftWheel)*60/2/pi
ans =  106.10 < 120
```

請繪出左右輪對時間之響應圖(合併於同一畫布中)、角度對時間響應圖&模擬圖說明

左右輪轉速11.11



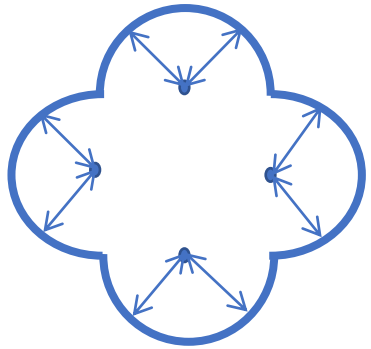


皆順時鐘轉72°

0~1秒，由90°逆時針轉18°
變成108°

HW02-4

- 輪型機器人之輪軸距離為10cm，輪子半徑為3cm，左右輪最大轉速為120rpm。
  - 機器人起始位置(2,2)，起始角度90°
  - 請完成下圖之移動軌跡(半徑皆為1公尺)



- 請計算出各時間區間之左右輪轉速
- 請繪出左右輪對時間之響應圖(合併於同一畫布中)、角度對時間響應圖、X-Y座標響應圖
- 模擬圖說明
- 程式碼以及其註解

推導輪軸距離為10cm，輪子半徑為3cm，要於18秒鐘繞完半徑1公尺的圓

假設要在十八秒，移動一個圓的距離，且半徑為1m

圓弧運動的半徑(r) = (l * (v_r + v_l)) / (2 * (v_l - v_r))

設右輪為x，左輪為y

1 = (0.1*(x+y)) / (2(y-x))

1 = (0.1x + 0.1y) / (2y-2x)

2y-2x = 0.1x + 0.1y

2.1x = 1.9y

x:y = 1.9 : 2.1

因此，若要依題目繞半個圓，只需將時間調為九秒即可

18秒移動一個圓的距離

$$V_B(t=0\sim18)=\frac{1m*2*pi}{18-0}=\frac{r(\omega_R(t_{0-18})+\omega_L(t_{0-18}))}{2}$$

$$\omega_R(t_{0-18})+\omega_L(t_{0-18})=\frac{2pi}{18}*\frac{2}{r=0.03}=\frac{4pi}{0.54}$$

$$\omega_R(t_{0-1})=\frac{4pi}{0.54}*\frac{1.9}{4}=11.05$$

$$\omega_L(t_{0-1})=\frac{4pi}{0.54}*\frac{2.1}{4}=12.21$$

程式驗證:

```
>> max(rightWheel)
ans =  11.054
>> max(leftWheel)
ans =  12.217
>> max(leftWheel)*60/2/pi
ans =  116.67
```

EX. 機器人起始位置(2,2)，起始角度90°

- $t = 0$~1，角度轉動90
- $t = 1$~10，移動半徑為1m的半圓
- $t = 10$~11，角度轉動90°
- $t = 11$~20，移動半徑為1m的半圓
- $t = 20$~21，角度轉動90°
- $t = 21$~30 ，移動半徑為1m的半圓
- $t = 30$~31，角度轉動90°
- $t = 31$~40，移動半徑為1m的半圓

請計算出各時間區間之左右輪轉速

$$\omega_B(t = 0\sim1) = \frac{90° * \frac{\pi}{180°}}{1 - 0} = \frac{r(\omega_R(t_{0-1}) - \omega_L(t_{0-1}))}{L}$$

$$\omega_R(t_{0-1}) - \omega_L(t_{0-1}) = \frac{90}{1} * \frac{0.1}{0.03} = 300$$

$$\omega_R(t_{0-1}) = 150 * \frac{\pi}{180}$$

$$\omega_L(t_{0-1}) = -150 * \frac{\pi}{180}$$

$$\omega_R(t_{1-10}) = 11.05$$

已於上頁推導

$$\omega_L(t_{1-10}) = 12.21$$

$$V_B(t = 10\sim11) = \frac{90° * \frac{\pi}{180°}}{10 - 11} = \frac{r(\omega_R(t_{10-11}) + \omega_L(t_{10-11}))}{\mathrm{L}}$$

$$\omega_R(t_{10-11}) + \omega_L(t_{10-11}) = \frac{90}{1} * \frac{0.1}{r=0.03} = 300$$

$$\omega_R(t_{10-11}) = 150 * \frac{\pi}{180}$$

$$\omega_L(t_{10-11}) = -150 * \frac{\pi}{180}$$

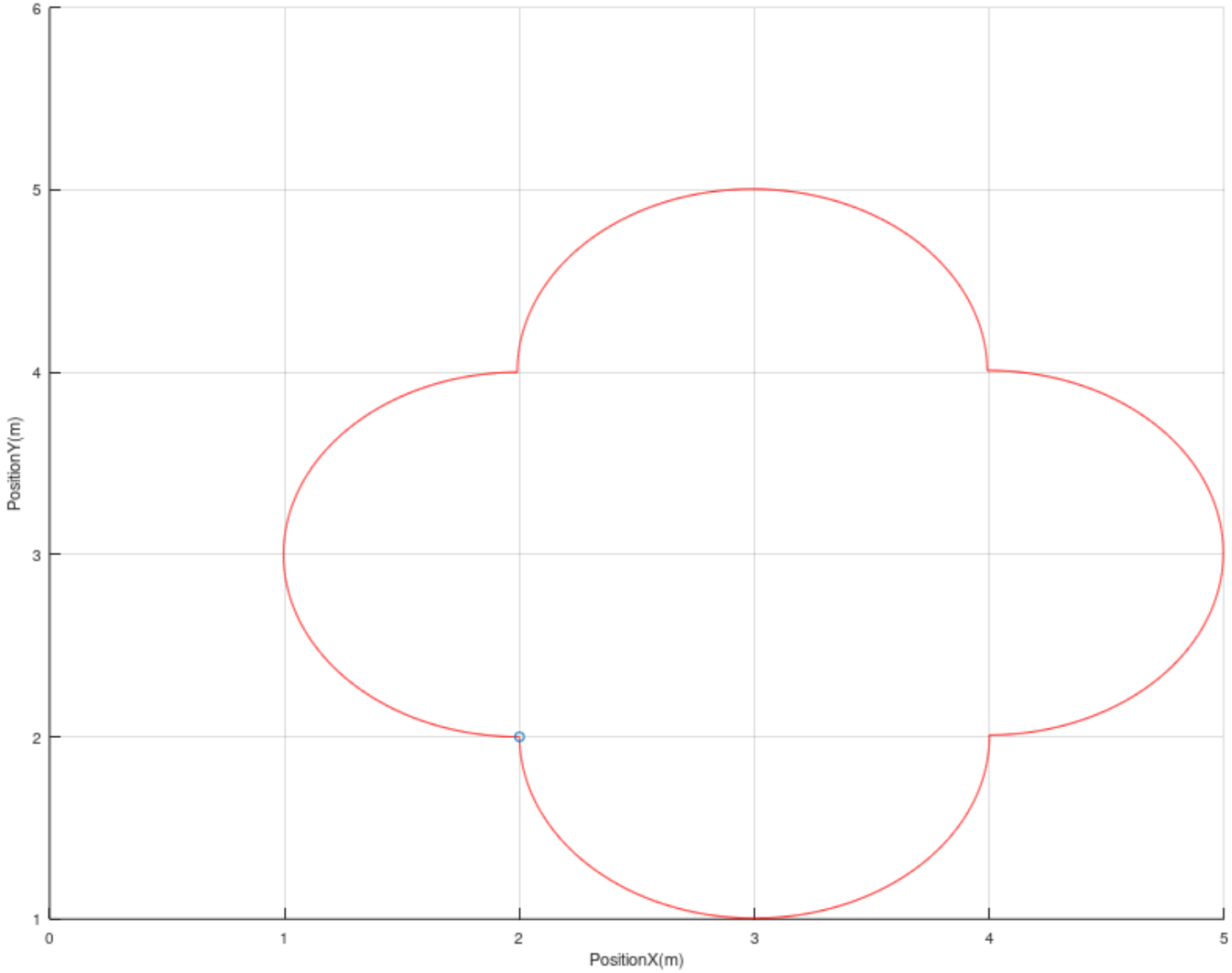
……重複……

```
if time <= 1
  Wheel = fun_robotRotation(1, pi*(90/180), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 10
  Wheel = fun_robotRotation(9, -pi, 1);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 11
  Wheel = fun_robotRotation(1, pi*(90/180), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 20
  Wheel = fun_robotRotation(9, -pi, 1);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 21
  Wheel = fun_robotRotation(1, pi*(90/180), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 30
  Wheel = fun_robotRotation(9, -pi, 1);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 31
  Wheel = fun_robotRotation(1, pi*(90/180), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 40
  Wheel = fun_robotRotation(9, -pi, 1);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
else
  Wheel = [0 0];
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
endif
```

```
>> max(rightWheel)
ans =  11.054
>> max(leftWheel)
ans =  12.217
>> max(leftWheel)*60/2/pi
ans =  116.67
```

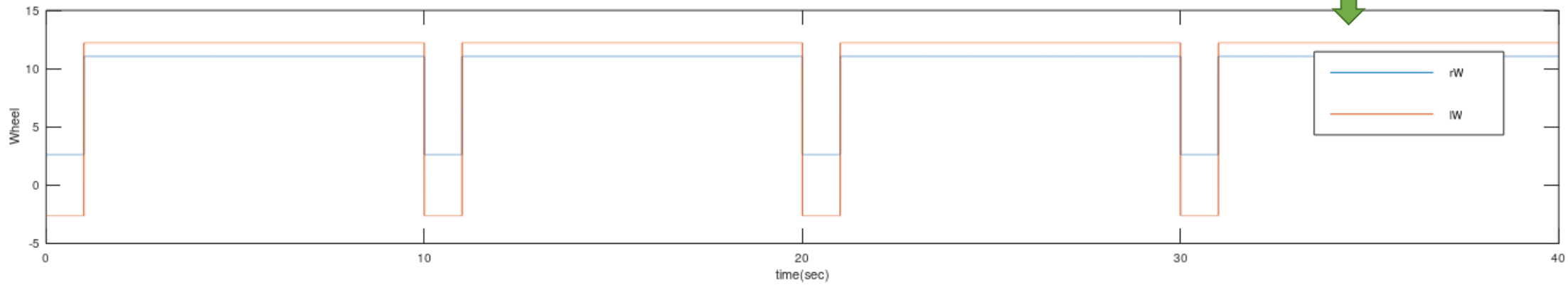
<120

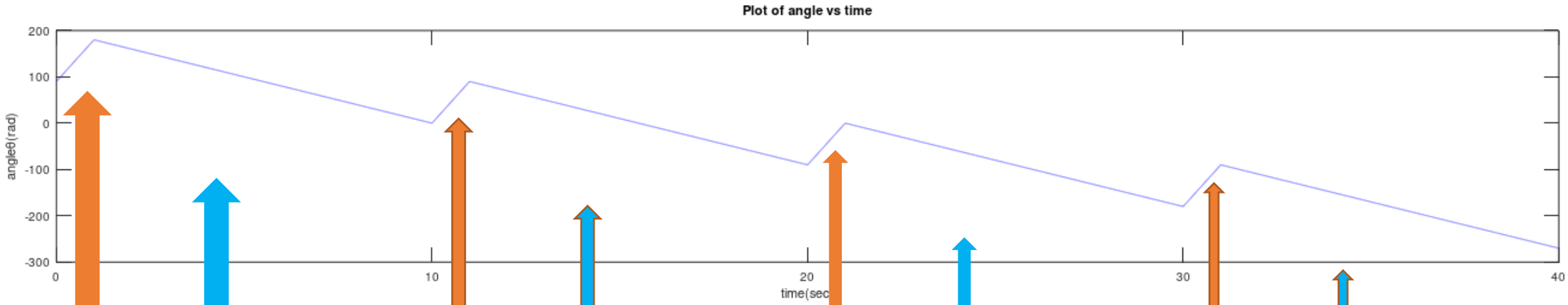
- X-Y座標響應圖



請繪出左右輪對時間之響應圖(合併於同一畫布中)、角度對時間響應圖，模擬圖說明

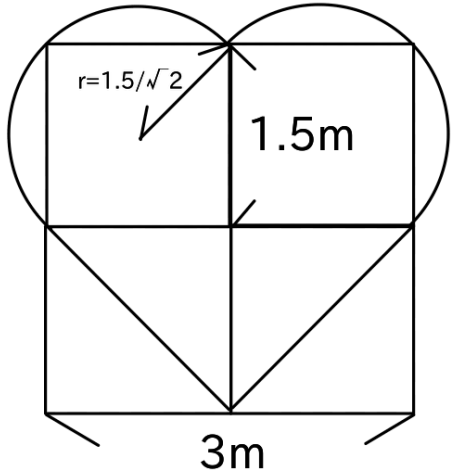
左輪轉速:12.21　　右輪轉速:11.05





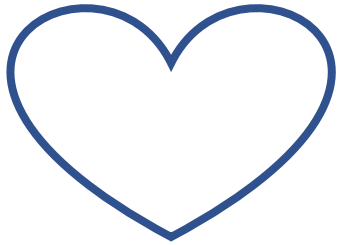
角度轉動90°

繞半圈，角度轉動-180°



HW02-5

- 輪型機器人之輪軸距離為10cm，輪子半徑為3cm，左右輪最大轉速為120rpm。
  - 機器人起始位置(2,2)，起始角度90°
  - 請完成下圖之移動軌跡(長寬各至少3公尺)



- 請計算出各時間區間之左右輪轉速
- 請繪出左右輪對時間之響應圖(合併於同一畫布中)、角度對時間響應圖、X-Y座標響應圖
- 模擬圖說明
- 程式碼以及其註解

推導:輪軸距離為10cm，輪子半徑為3cm，要於18秒鐘繞完半徑$\frac{1.5}{\sqrt{2}}$公尺的圓

假設要在十八秒，移動一個圓的距離，且半徑為$\frac{1.5}{\sqrt{2}}$ m

圓弧運動的半徑(r) = (l * (v_r + v_l)) / (2 * (v_l - v_r))

設右輪為x，左輪為y

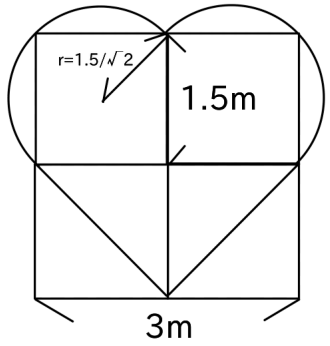
$\frac{1.5}{\sqrt{2}}$ = (0.1*(x+y)) / (2(y-x))

$\frac{1.5}{\sqrt{2}}$ = (0.1x + 0.1y) / (2y-2x)

$\frac{3}{\sqrt{2}}$y-$\frac{3}{\sqrt{2}}$x = 0.1x + 0.1y

x:y =2.0213:2.2213

移動一個圓的距離



$$V_B(t=0\sim18)=\frac{\frac{1.5}{\sqrt{2}}m*2*pi}{18-0}=\frac{r(\omega_R(t_{1-2})+\omega_L(t_{1-2}))}{2}$$

$$\omega_R(t_{0-18})+\omega_L(t_{0-18})=\frac{\frac{3}{\sqrt{2}}pi}{18}*\frac{2}{r=0.03}=\frac{\frac{6}{\sqrt{2}}pi}{0.54}=24.683$$

$$\omega_R(t_{0-18})=24.683*(2.0213/4.2426)=11.76$$

$$\omega_L(t_{0-18})=24.683*(2.2213/4.2426)=12.923$$

```
>> max(rightWheel)
ans =  11.760
>> max(leftWheel)
ans =  12.923
```

因此，若要依題目繞半個圓，只需將時間調為九秒即可

EX. 機器人起始位置(2,2)，起始角度90°

- $t = 0\sim2$，角度轉動45°
- $t = 2\sim11$，走半圓
- $t = 11\sim12$，角度轉動90°
- $t = 12\sim21$ ，走半圓
- $t = 21\sim28$，前進2R的距離
- $t = 28\sim29$ ，角度轉動−90°
- $t = 29\sim36$ ，前進2R的距離

請計算出各時間區間之左右輪轉速

$$\omega_B(t = 0\sim2) = \frac{45° * \frac{\pi}{180°}}{2\ -0} = \frac{r(\omega_R(t_{0-1}) - \omega_L(t_{0-1}))}{L}$$

$$\omega_R(t_{0-1}) - \omega_L(t_{0-1}) = \frac{45}{2} * \frac{0.1}{0.03} = 75$$

$$\omega_R(t_{0-1}) = 37.5 * \frac{\pi}{180}$$

$$\omega_L(t_{0-1}) = -37.5 * \frac{\pi}{180}$$

$$\omega_R(t_{2-11}) = 11.76$$

$$\omega_L(t_{2-11}) = 12.923$$

$$V_B(t = 11\sim12) = \frac{90° * \frac{\pi}{180°}}{12\ -11} = \frac{r(\omega_R(t_{11-12}) - \omega_L(t_{11-12}))}{L}$$

$$\omega_R(t_{11-12}) - \omega_L(t_{11-12}) = \frac{90}{1} * \frac{0.1}{0.03} = 300$$

$$\omega_R(t_{1.5-2.5}) = 150 * \frac{\pi}{180}$$

$$\omega_L(t_{1.5-2.5}) = -150 * \frac{\pi}{180}$$

$$V_B(t = 21\sim28) = \frac{\frac{3}{\sqrt{2}}}{28 - 21} = \frac{r(\omega_R(t_{21-28}) + \omega_L(t_{21-28}))}{2}$$

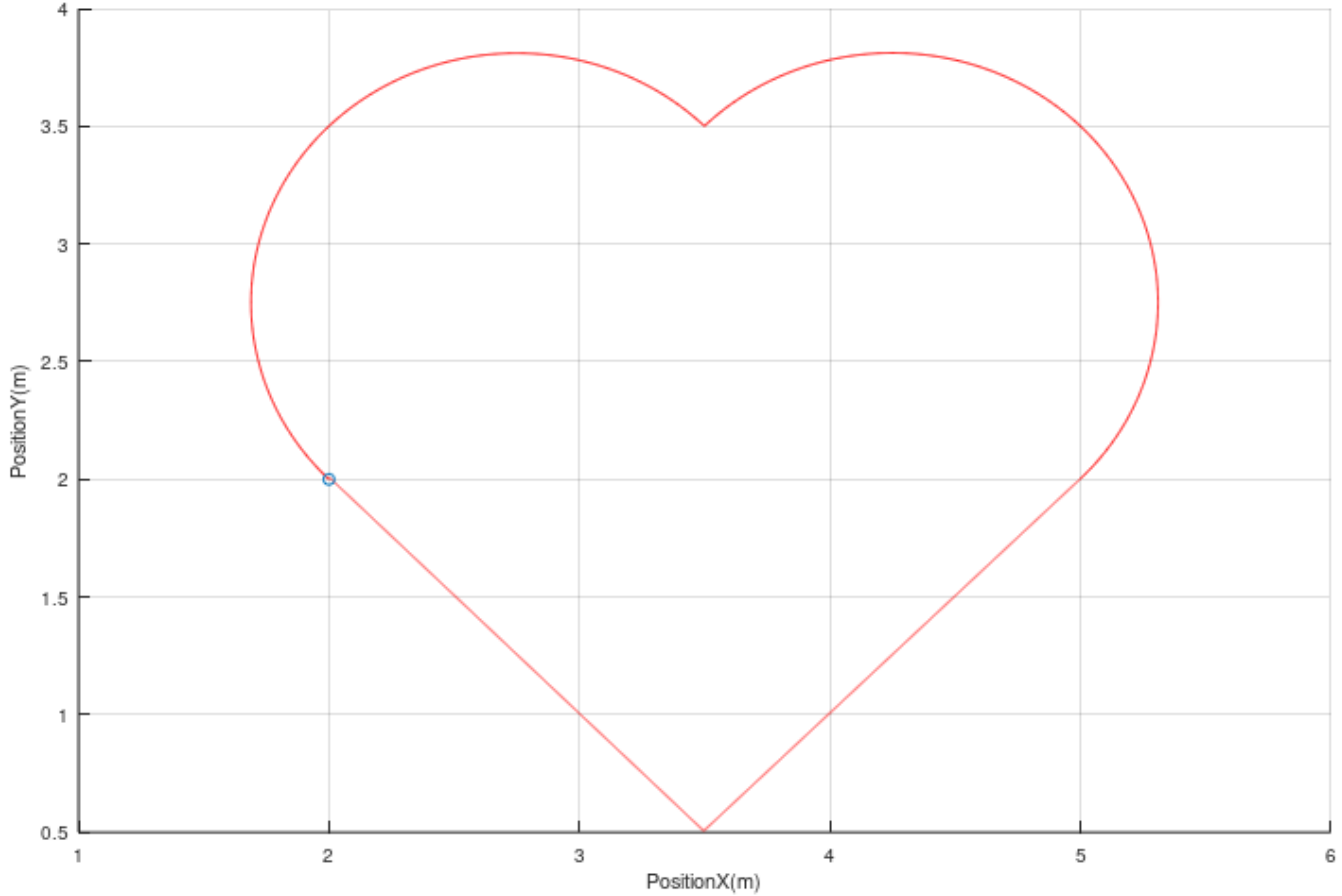
$$\omega_R(t_{21-28}) + \omega_L(t_{21-28}) = \frac{\frac{3}{\sqrt{2}}}{7} * \frac{2}{r = 0.03} = \frac{\frac{6}{\sqrt{2}}}{0.21}$$

$$\omega_R(t_{21-28}) = \frac{\frac{6}{\sqrt{2}}}{0.42} = 10.101$$

$$\omega_L(t_{21-28}) = \frac{\frac{6}{\sqrt{2}}}{0.42} = 10.101$$

```
if time <= 2
  Wheel = fun_robotRotation(2, pi*(45/180), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 11
  Wheel = fun_robotRotation(9, -pi, 1.5/(2^0.5));
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 12
  Wheel = fun_robotRotation(1, pi*(90/180), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 21
  Wheel = fun_robotRotation(9, -pi, 1.5/(2^0.5));
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 28
  Wheel = fun_robotStraight(7,3/(2^0.5));
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 29
  Wheel = fun_robotRotation(1, pi*(-90/180), 0);
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
elseif time <= 36
  Wheel = fun_robotStraight(7,3/(2^0.5));
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
else
  Wheel = [0 0];
  rightWheel(iter) = Wheel(1);
  leftWheel(iter) = Wheel(2);
endif
```

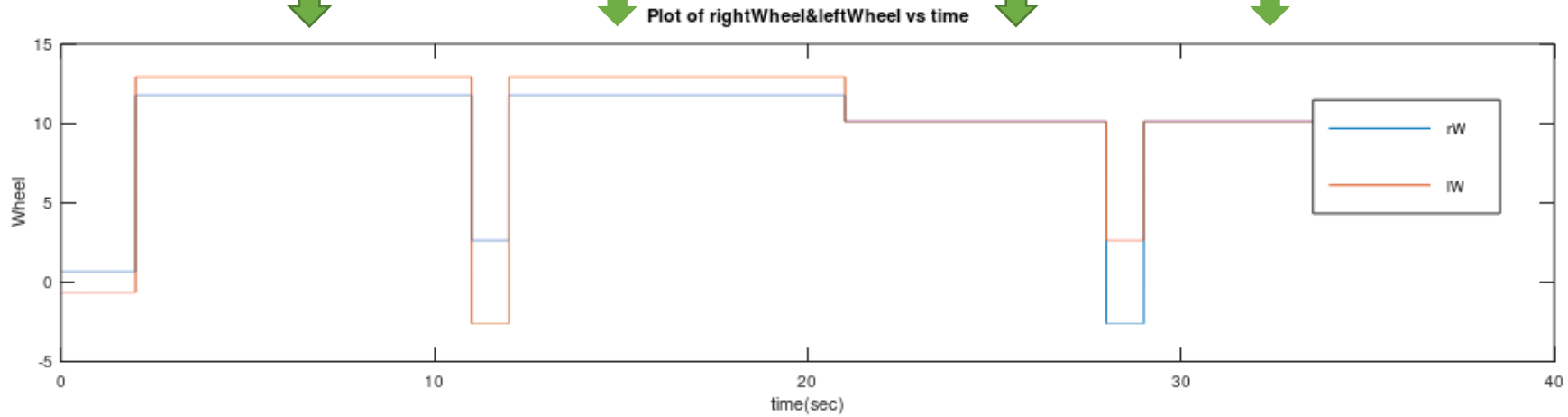
- X-Y座標響應圖

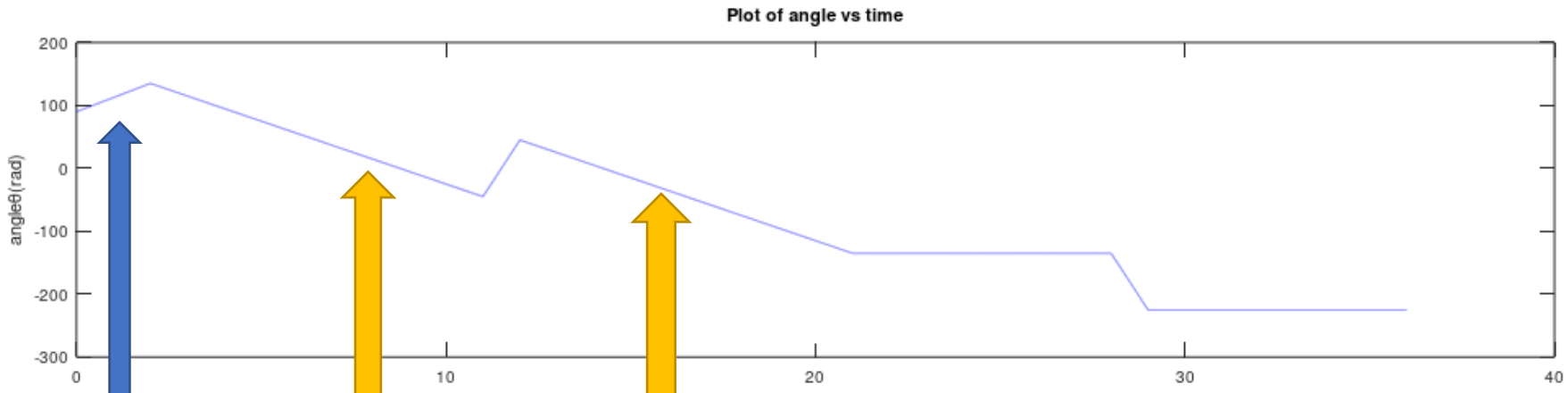


請繪出左右輪對時間之響應圖(合併於同一畫布中)、角度對時間響應圖

繞半圓 左輪:12.923　右輪:11.76

直走 左右輪:10.101





原本90°
轉45°變135°

轉半圓，
轉角-180°