



智慧型機器人概論

# Introduction to Intelligent Robotics

**Week 10**

**旋轉伺服機**

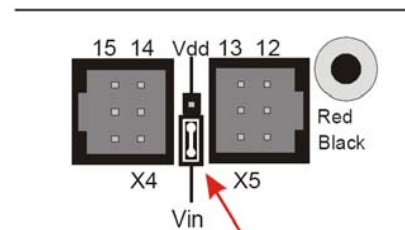
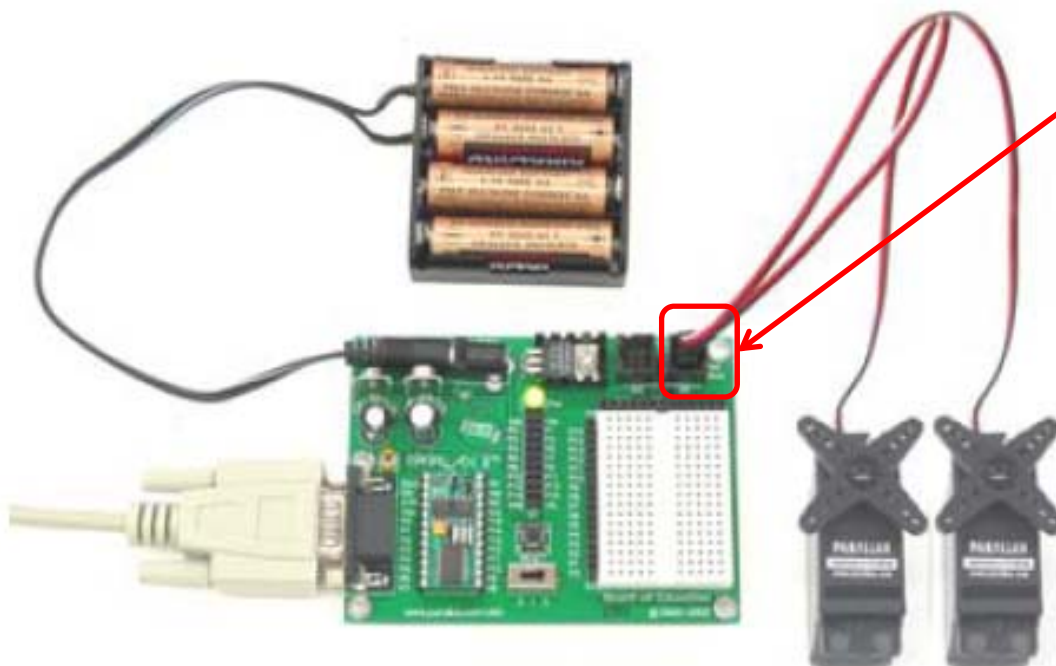
長庚大學 資訊管理學系  
林維昭 Wei-Chao (Vic) Lin  
[viclin@gap.cgu.edu.tw](mailto:viclin@gap.cgu.edu.tw)



# 旋轉伺服機



# 與BOE連結

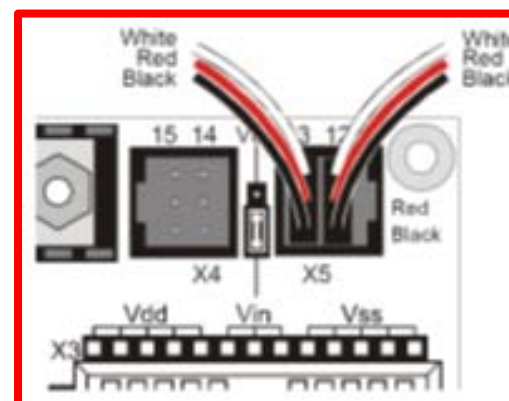
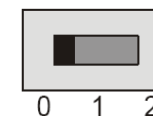


Select Vin if you are using the battery pack that comes with the Boe-Bot kits.

**\*\*連接前先關電原**

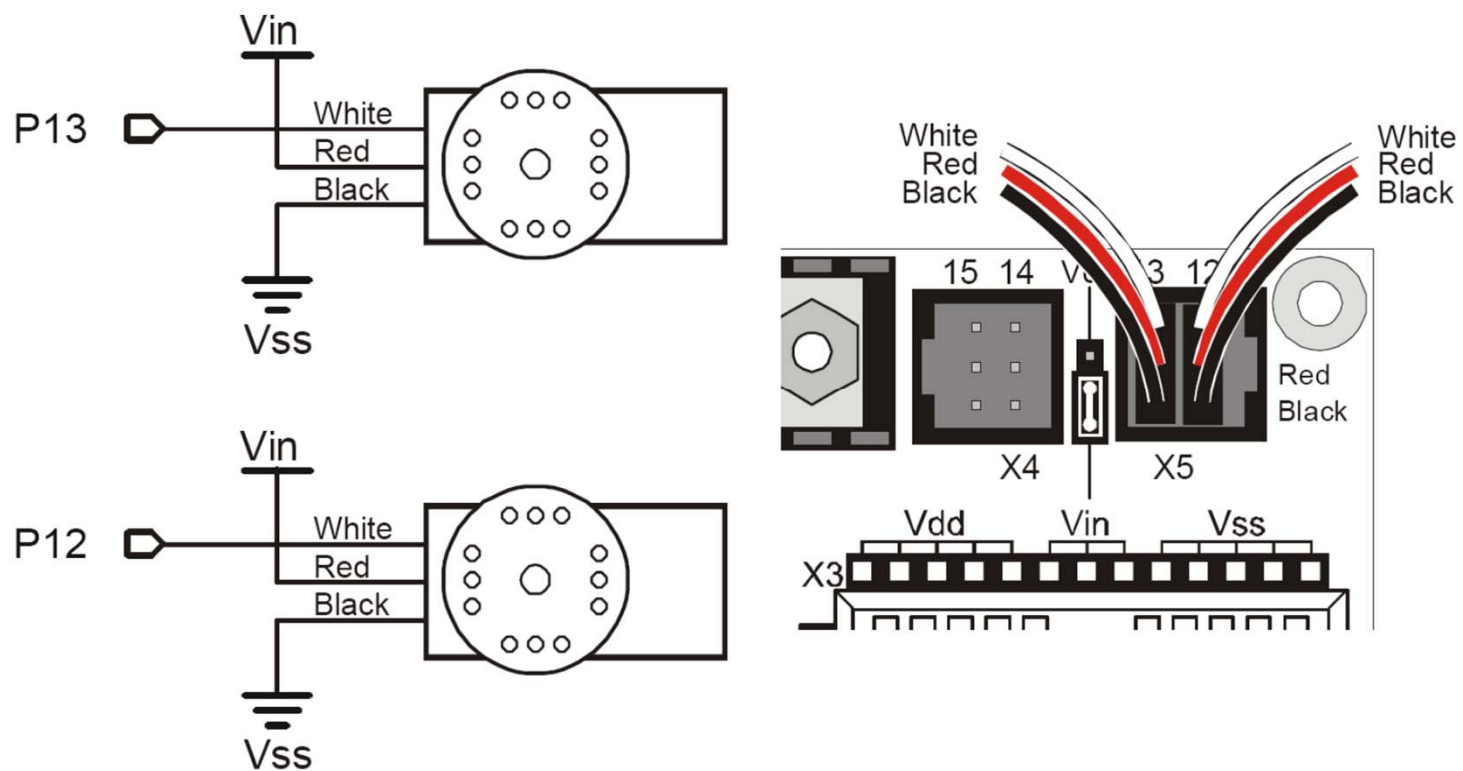


Reset





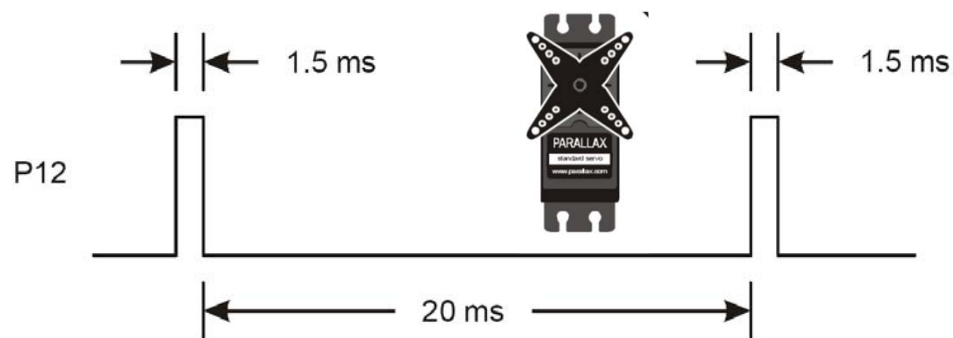
# 與BOE連結



# 伺服馬達測試

■ PULSOUT port, 時脈

■ 停止 (pulsout 750)



```
'{$STAMP BS2}  
'{$PBASIC 2.5}
```

```
DO  
  PULSOUT 12, 750  
LOOP
```

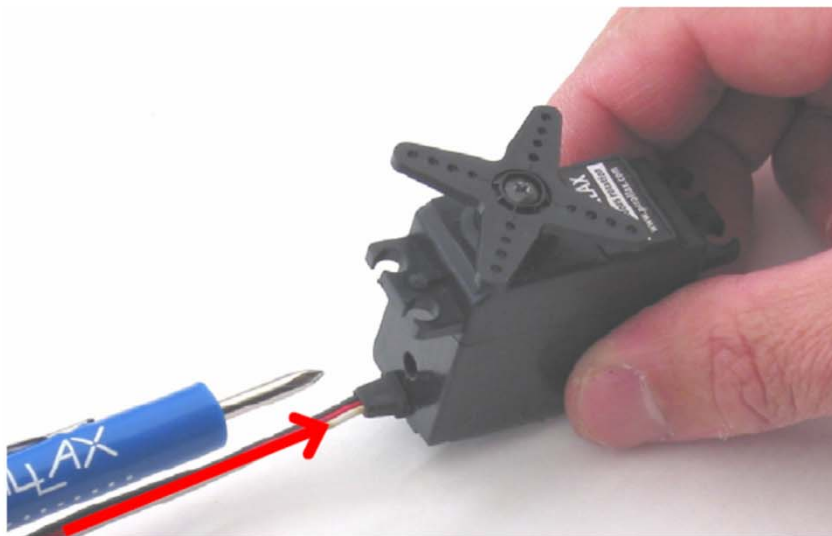


0 1 2

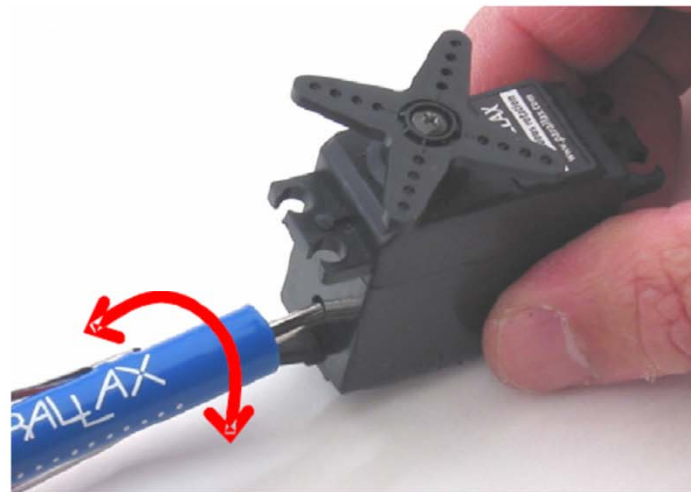
開關: 2  
輪胎轉動

# 伺服馬達測試

- 旋轉到伺服馬達停止轉動-用螺絲起子



Insert tip of Phillips screwdriver into potentiometer access hole.

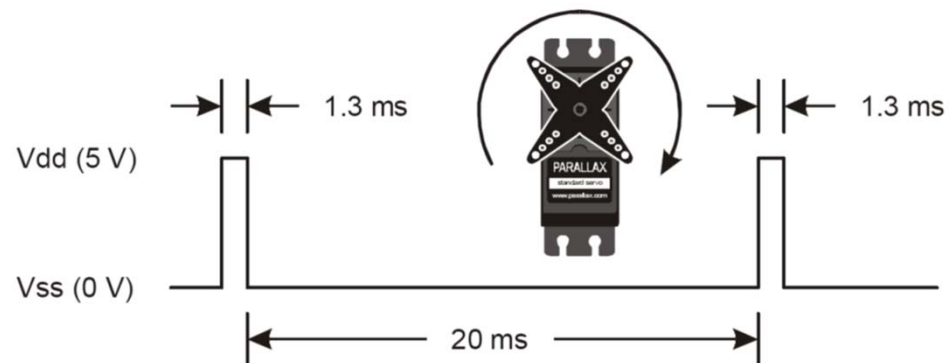


Gently turn screwdriver to adjust potentiometer



# 伺服馬達測試

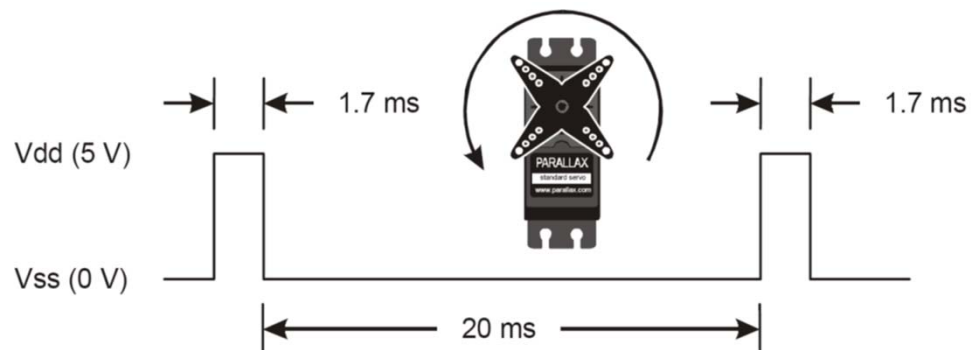
## ■ 順時針 (PULSOUT 650)



```
'{$STAMP BS2}  
'{$PBASIC 2.5}
```

```
DO  
  PULSOUT 12, 650  
LOOP
```

## ■ 逆時針 (PULSOUT 850)



```
'{$STAMP BS2}  
'{$PBASIC 2.5}
```

```
DO  
  PULSOUT 12, 850  
LOOP
```

# PWM脈波轉換

## ■ PAUSE

- 1/1000 秒
- LED每秒閃爍明暗一次

```
'{$STAMP BS2}  
'{$PBASIC 2.5}
```

```
DO  
  HIGH 14  
  PAUSE 500  
  LOW 14  
  PAUSE 500  
LOOP
```

## ■ PULSOUT

- 2/百萬 秒
- PULSOUT 12, 1

- 2μs

- PULSOUT 12, 2

- 4μs



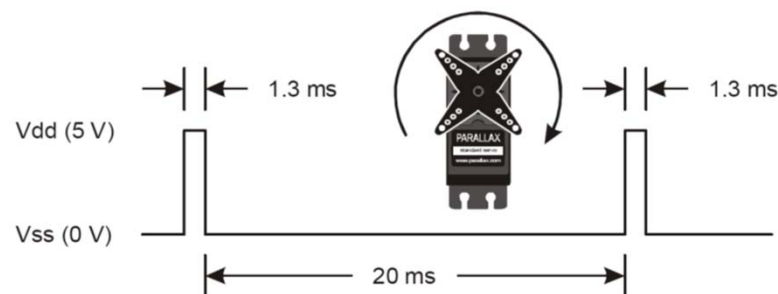
# 伺服馬達控制

< 650 慢

## □ PULSOUT 12, 650

■  $1300\mu\text{s} = 1.3\text{ms}$

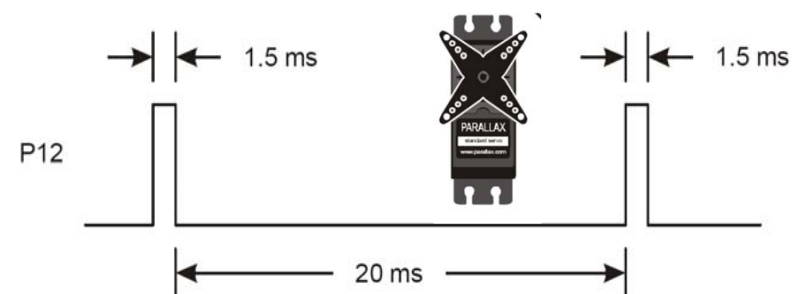
■ 全速順時針



## □ PULSOUT 12, 750

■  $1500\mu\text{s} = 1.5\text{ms}$

■ 停止

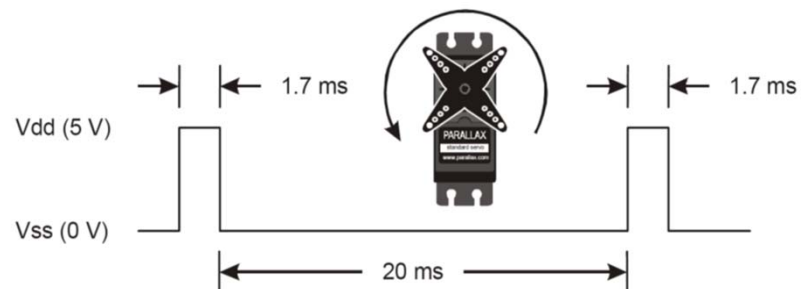


## □ PULSOUT 12, 850

■  $1700\mu\text{s} = 1.7\text{ms}$

■ 全速逆時針

> 850 慢



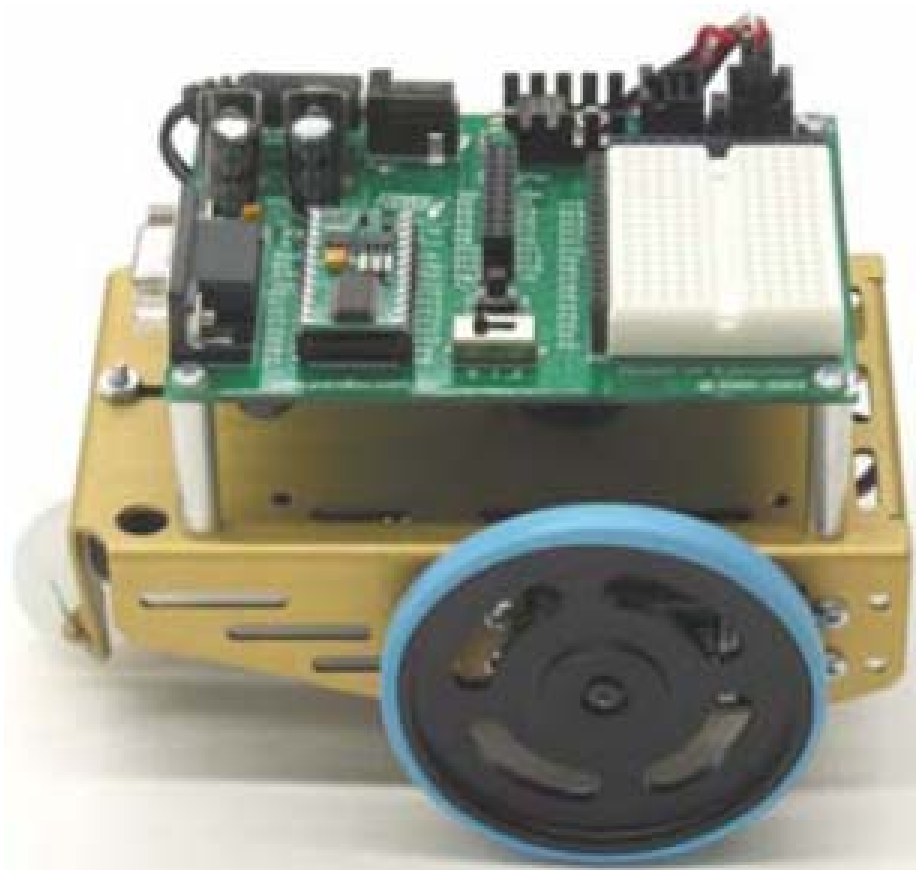
# BBcar

左

後

前

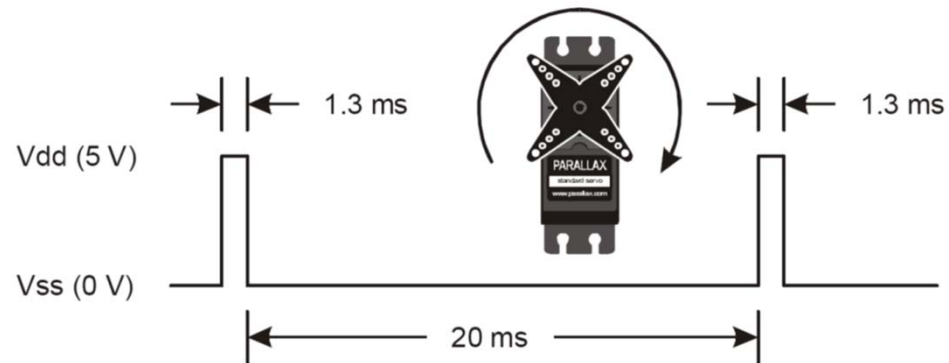
右





# BBcar 輪胎轉動

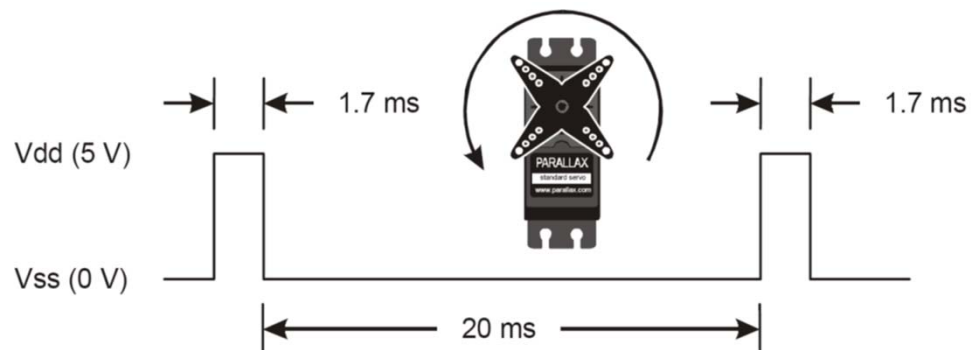
## ■ 順時針 (PULSOUT 650)



```
'{$STAMP BS2}  
'{$PBASIC 2.5}
```

```
DO  
  PULSOUT 12, 650  
LOOP
```

## ■ 逆時針 (PULSOUT 850)



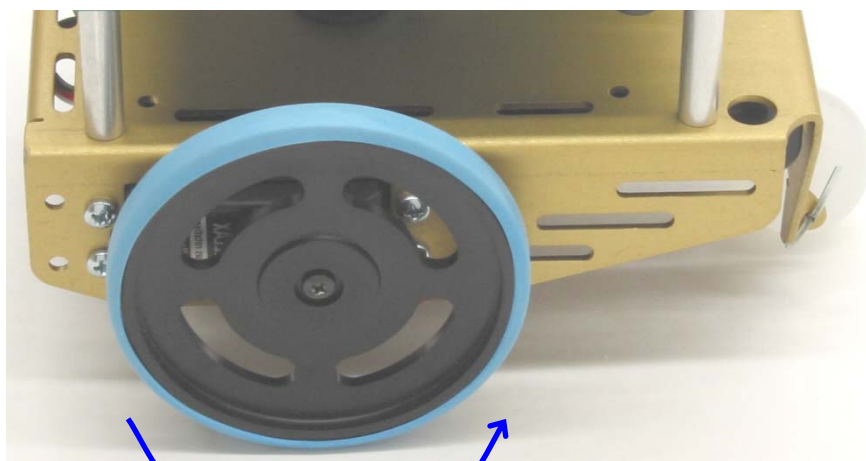
```
'{$STAMP BS2}  
'{$PBASIC 2.5}
```

```
DO  
  PULSOUT 12, 850  
LOOP
```

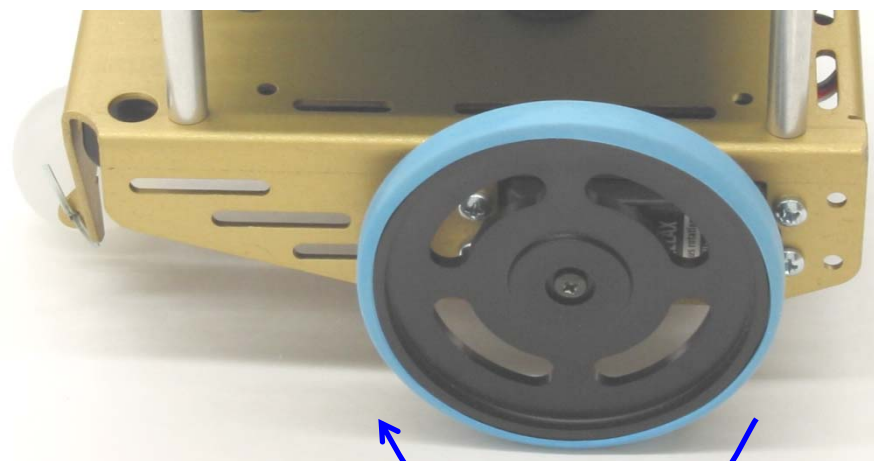
前進

右輪

左輪



逆時針



順時針

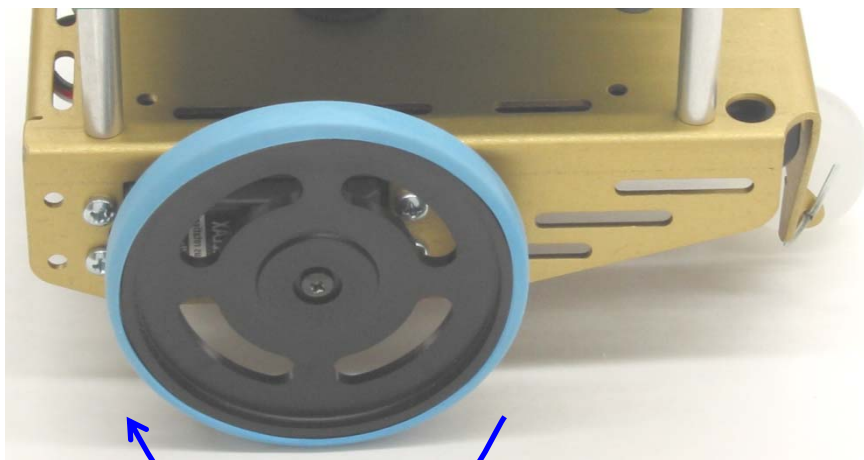




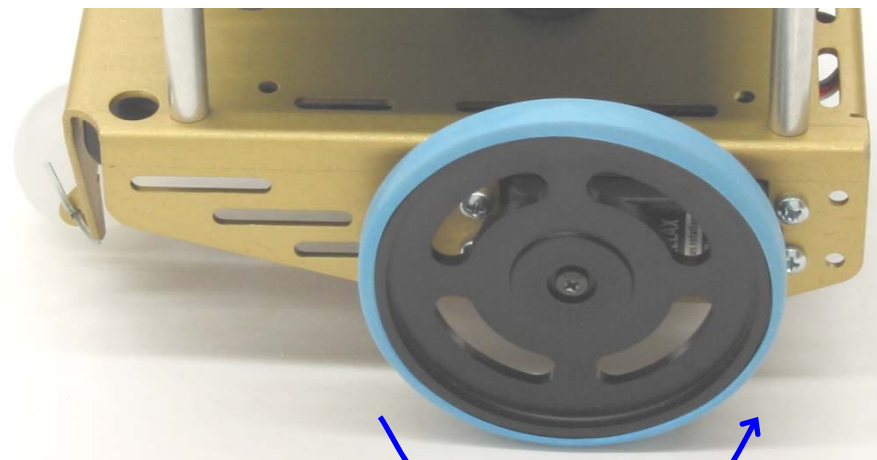
後退

右輪

左輪



順



逆



# Work I

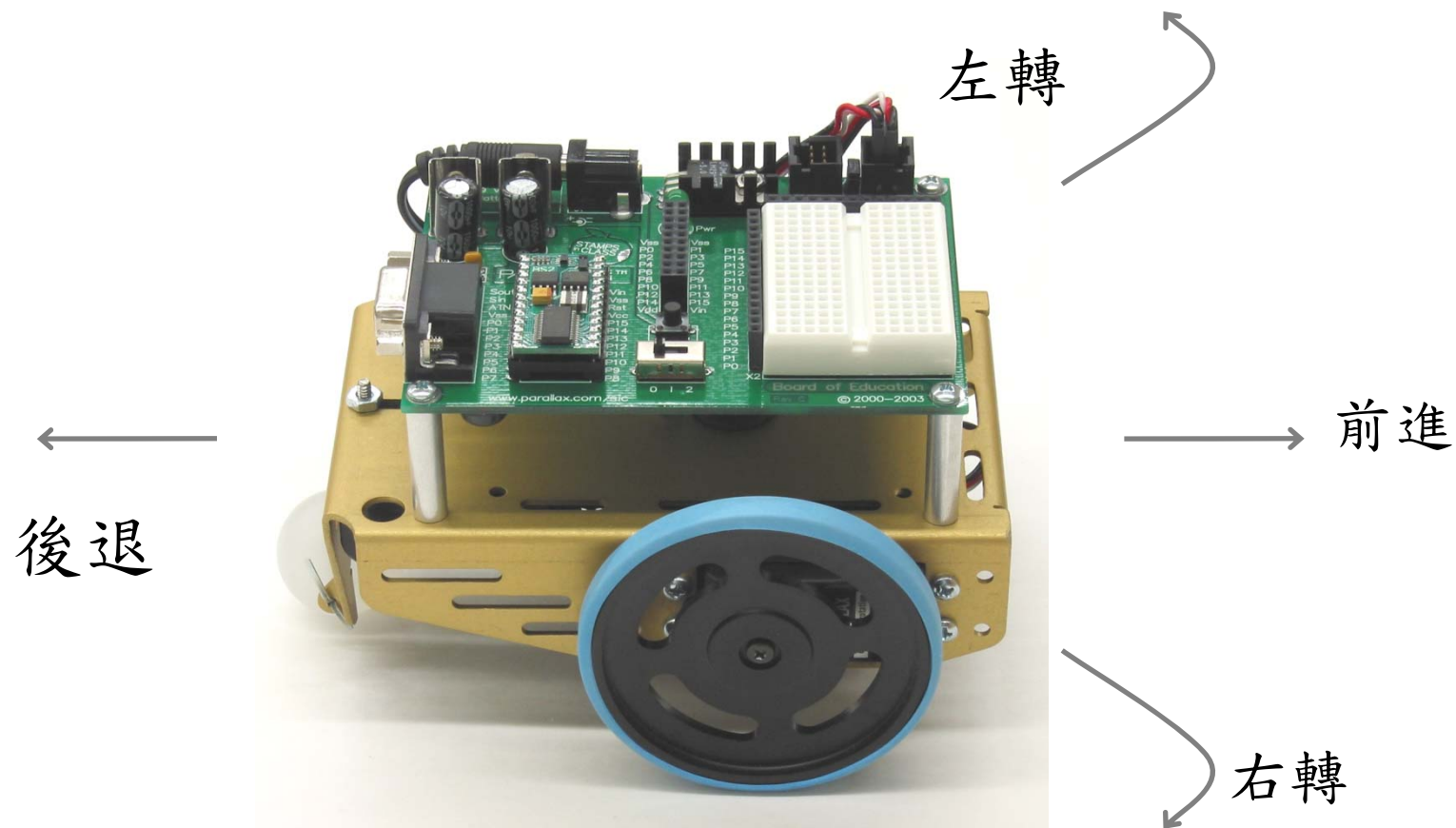
- BBcar 前進/後退

- BB car 前進

- BB car 後退



# BBcar 操作

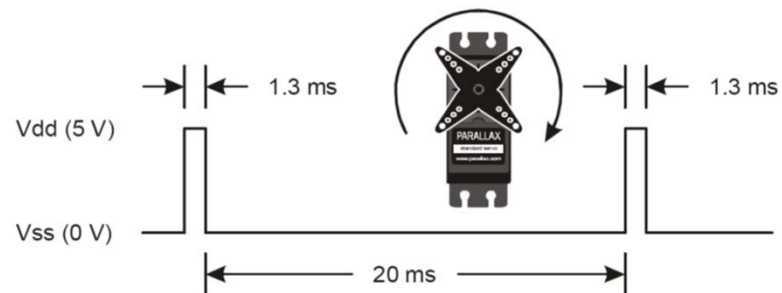


# 伺服馬達控制

## □ PULSOUT 12, 650

■  $1300\mu\text{s} = 1.3\text{ms}$

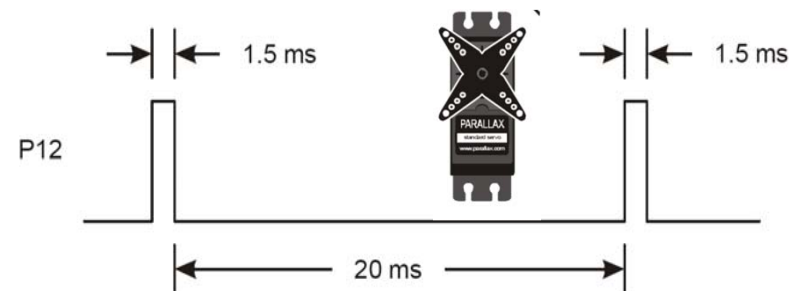
■ 全速順時針



## □ PULSOUT 12, 750

■  $1500\mu\text{s} = 1.5\text{ms}$

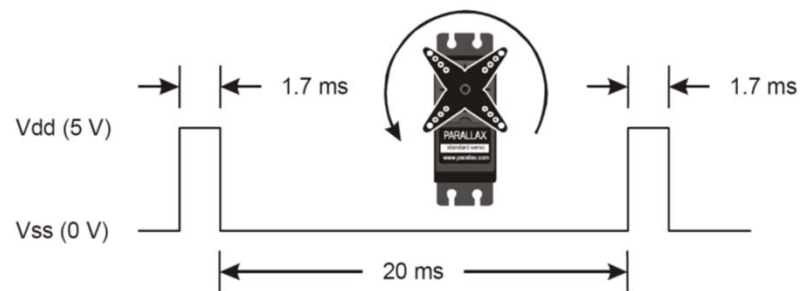
■ 停止



## □ PULSOUT 12, 850

■  $1700\mu\text{s} = 1.7\text{ms}$

■ 全速逆時針





# 讓BBcar前進3秒 (距離)

## ■ FOR-NEXT 迴圈

□ 複習: LED on-off 10 times

```
Counter VAR Byte

FOR Counter = 1 TO 10
  DEBUG ? Counter
  HIGH 14
  PAUSE 500
  LOW 14
  PAUSE 500
NEXT

DEBUG "All Done!"
END
```

# 讓BBcar前進3秒 (距離)

```
'{$STAMP BS2}  
'{$PBASIC 2.5}
```

counter VAR Word

FOR counter = 1 TO 122

PULSOUT 12, 650

PULSOUT 13, 850

PAUSE 20

NEXT

END

counter 變數宣告

'Run servos for 3 seconds. 前進3秒

右: 順時針

左: 逆時針

脈衝暫停20毫秒

$*122 \times 0.02s = 2.44s$  (約3s)



# 調整距離

## ■ FOR-NEXT

□ 3秒: 1 TO 122

□ 1.5秒: 1 TO 61

□ 1秒: 1 TO 40

□ 6秒: 1 TO 244

# 減速

## ■ PULSOUT

□ PULSOUT 12, 750

■ 停止

□ PULSOUT 的參數值接近讓伺服機停止旋轉的值 750，  
就能降低 BBcar 的速度

□ PULSOUT 12, 650    原     $\frac{720}{780}$     改     $\frac{750}{750}$   
PULSOUT 13, 850



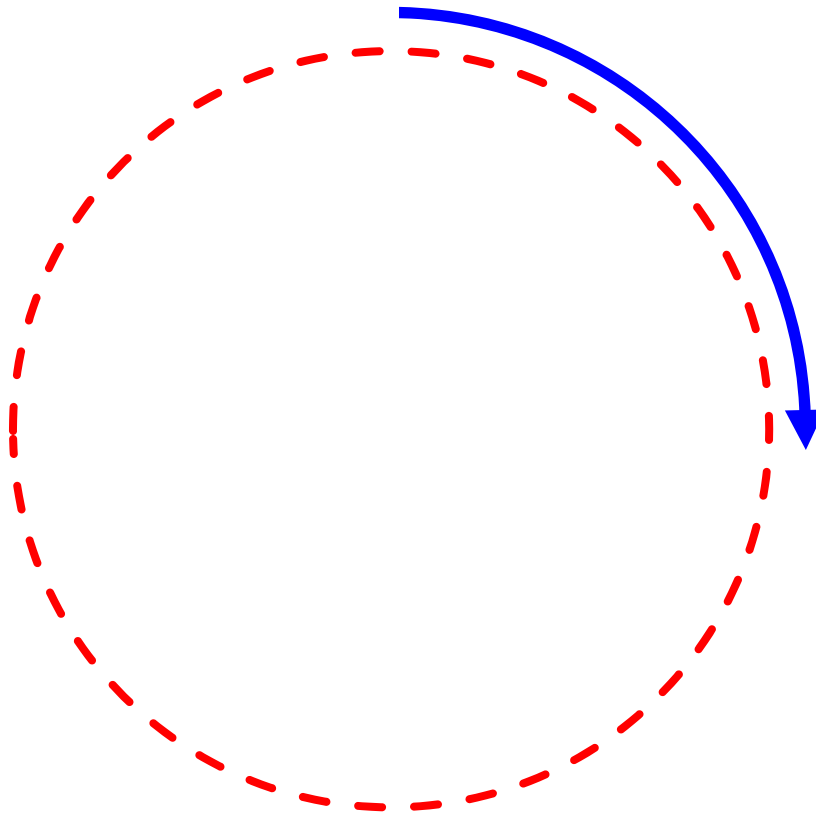
# 後退、轉彎

## ■ PULSOUT

	前進	後退	右轉	左轉
12 (右)	650	850	850	650
13 (左)	850	650	850	650

# 轉彎

■ 1/4 turn





# 轉彎

## ■ 右轉 1/4 turn

□ 距離 ► 時間

'{\$STAMP BS2}

'{\$PBASIC 2.5}

counter VAR Word

FOR counter = 1 TO 20  
turn

'Rotate left - about 1/4

PULSOUT 12, 850

PULSOUT 13, 850

PAUSE 20

NEXT

# 轉彎

## ■ 左轉 1/4 turn

□ 距離 ► 時間

'{\$STAMP BS2}

'{\$PBASIC 2.5}

counter VAR Word

FOR counter = 1 TO 20  
turn

'Rotate right - about 1/4

PULSOUT 12, 650

PULSOUT 13, 650

PAUSE 20

NEXT



# 以中心旋轉

## ■ 讓BBcar以一個輪子為中心旋轉

□ 在於保持一個輪子靜止而另一個輪子轉動

□ 動作

■ 向前轉到右側

■ 向後轉到右側

■ 向前轉到左側

■ 向後轉到左側

□ PULSOUT

	前/右	後/右	前/左	後/左
12 (右)	750	750	650 (順)	850 (逆)
13 (左)	850 (逆)	650 (順)	750	750

# 以中心旋轉

## ■ 1/4 turn的時間

'{\$STAMP BS2}

'{\$PBASIC 2.5}

counter VAR Word

FOR counter = 1 TO 40 'about 1/4 turn

PULSOUT 12, 750

PULSOUT 13, 850

PAUSE 20

NEXT



# 計算距離

$$\text{time} = \frac{\text{distance}}{\text{speed}}$$

$$\text{time} = \frac{\text{BBcar running distance}}{\text{BBcar's speed}}$$



# 計算距離

## ■ 先測試 BBcar 的速度

□ BBcar 前進1秒鐘，所走的距離

```
'{$STAMP BS2}  
'{$PBASIC 2.5}
```

counter VAR Word

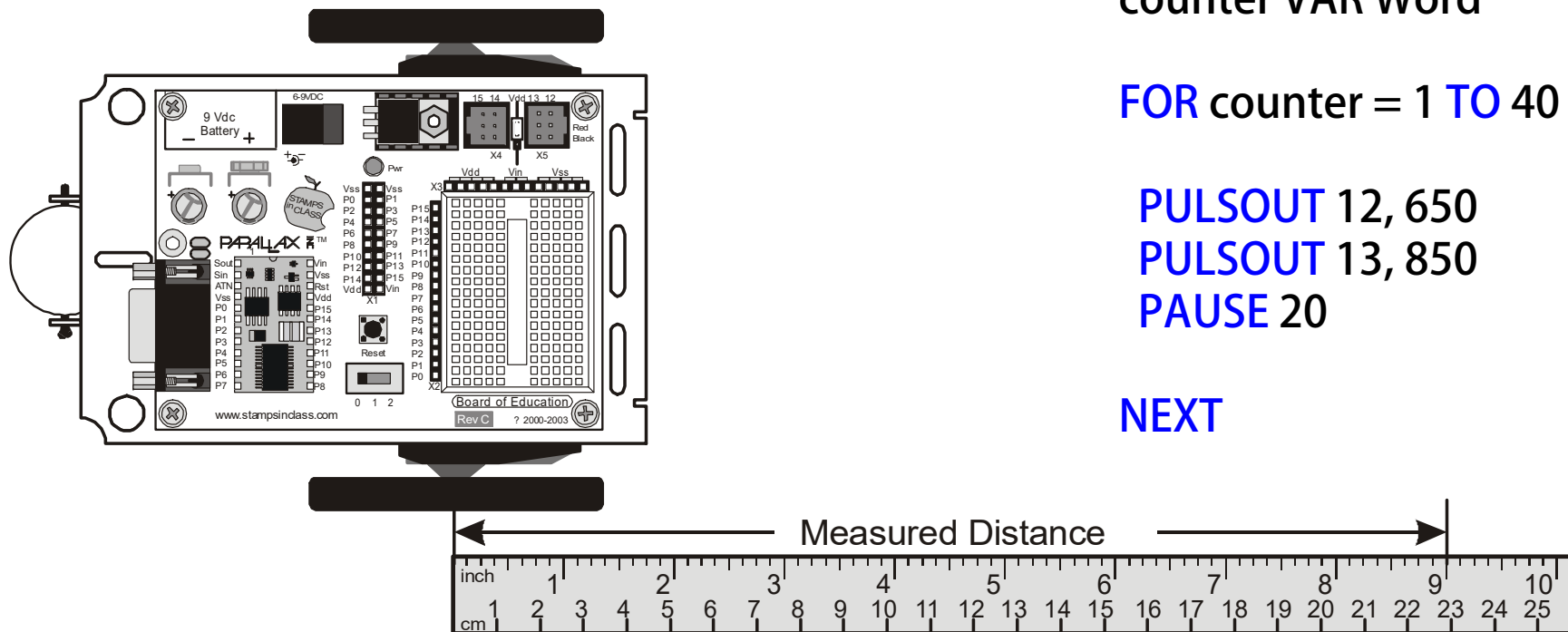
FOR counter = 1 TO 40

PULSOUT 12, 650

PULSOUT 13, 850

PAUSE 20


NEXT



# 計算距離

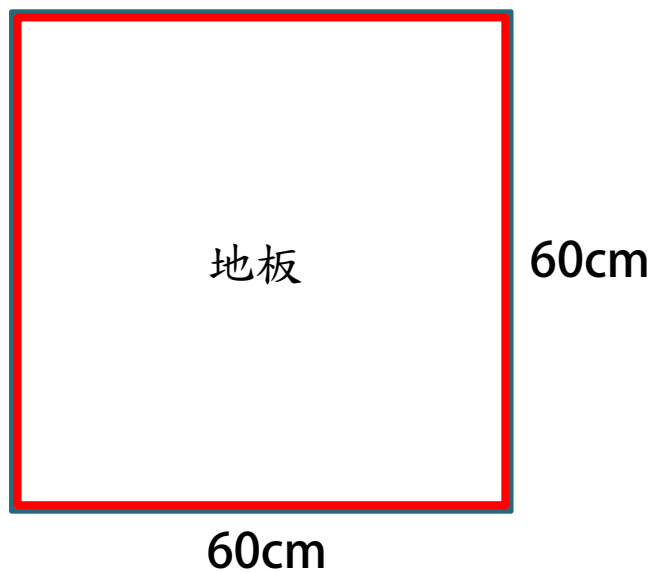
- 假設 BBcar 運行了 19cm，共花費了 1 秒鐘
  - BBcar 的速度約是 19cm/s
  - 現在你可以計算讓 BBcar 到達特定距離所需要的時間
- 51 cm 需花費的時間？

$$\text{time} = \frac{51\text{cm}}{19\text{cm/s}} = 2.68\text{s}$$

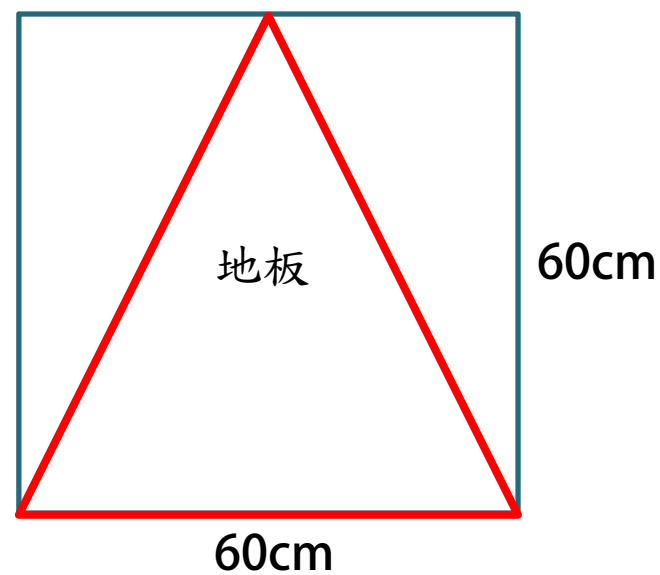
- **FOR** counter = 1 **TO** ? 107 or 108
  - $40 \times 2.68\text{s} = 107.37$  

# Work II

## ■ BBcar 走正方形



## ■ BBcar 走三角形





# Work II

## ■ BBcar 走圓形

□ 直徑  $\approx 60\text{cm}$

