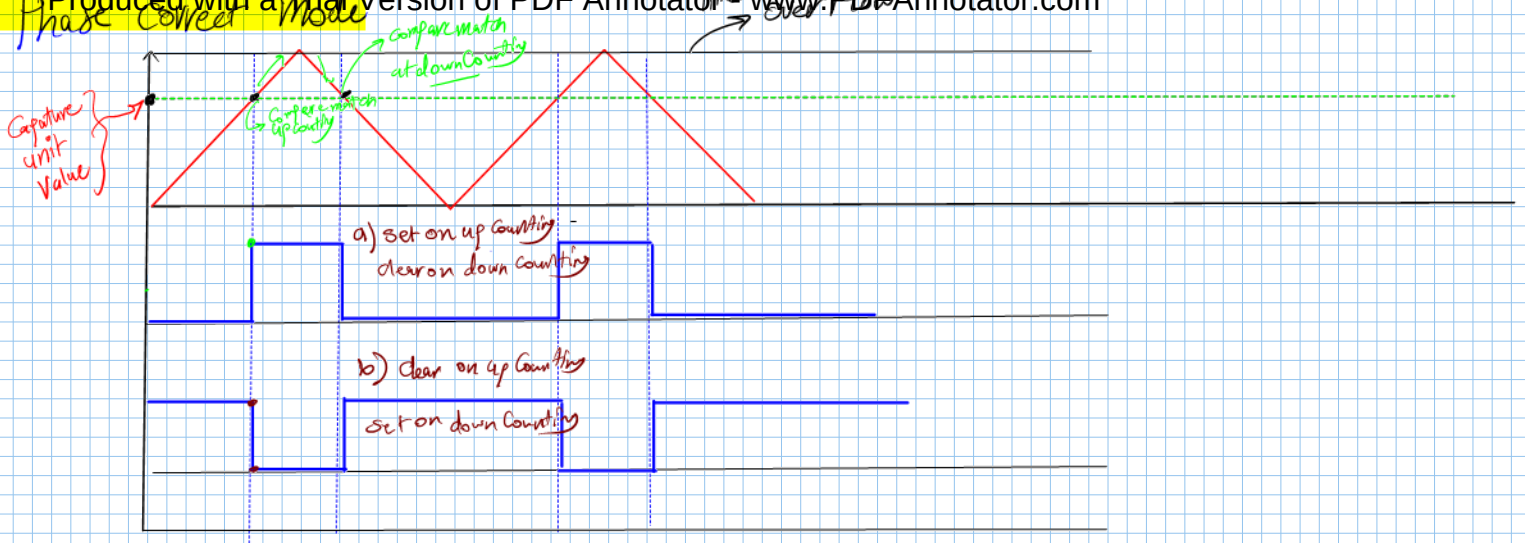
Phase Correct Mode



a) set on up Counting
clear on down Counting

* Period time = 2 * OVF time
* ON time = 2(OVF time − Compare match Value)
∴ Duty cycle = 1 − Compare match Value / OVF time

ON time / Period

Looks like inverting Mode in Fast PWM

Duty cycle ∝ 1 / compare match value

* Phase Correct
→ used in low Freq signals
Period time: Phase Correct = 2 Fast PWM

b) clear on up Counting
Set on down Counting

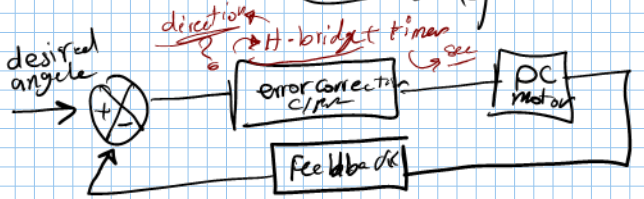
* Period time = 2 * OVF time
* ON time = 2 * Compare match Value
∴ Duty cycle = Compare Match Value / OVF time

PWM as a way of Communication

→ DC DC Converters (Buck module)
→ stepper motors drivers (Mach)

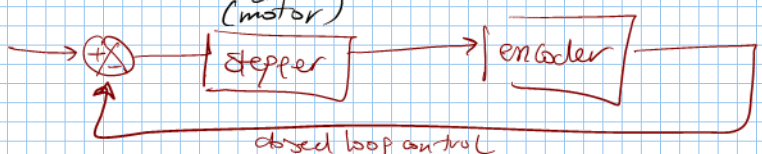
encoders → magnetic
→ optical
→ Rotary

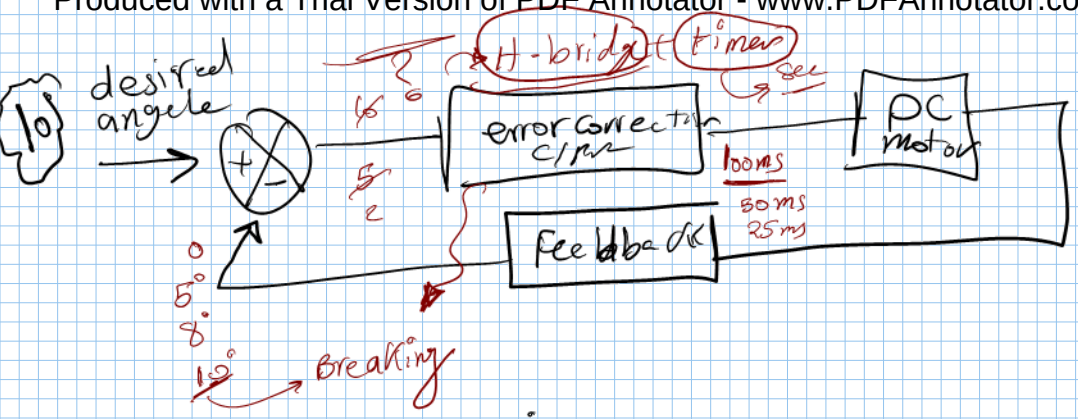
* Servo motor
→ feedback
→ Could be → dc (most use)
→ stepper



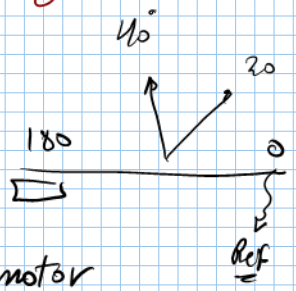
* DC motor → uncontrollable without extra How

* Stepper motor → high power motor
→ doesn't have feedback





limiting servo



- angle Control motor
- no speed Control

angleControl

* Continous PWM

Contiou Brake

Period time : 20ms

1 ms : 2ms ← ONTime

0 : 180

used potentiometer as a feedback

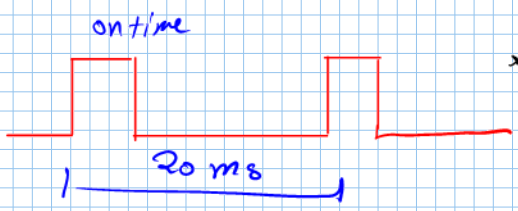
- more accurate

Continou servo

0 → 360°

- speed Control
- no angle Control

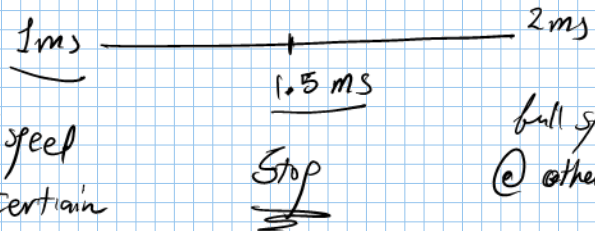
Speed Controll



* used encoder as a feedback

Period time : 20ms

1 ms : 2ms ← ONTime



full speed @ certain direction

Stop

full speed @ other direction

* Looks like controlling BDCM [ESC]

	DC motor	Stepper Motor	Servo motor
Controllability	X	✓	limited ✓
Cost	lowest	mid	highest Cost
weigth	↓ (Best)	↑ (worst)	mid
Power	↓ (Best)	↑ (worst)	mid

torque holding	no holding torque	activating all coils	go back to the req position
resolution	X	limited to angle step	limited to ADC resulation

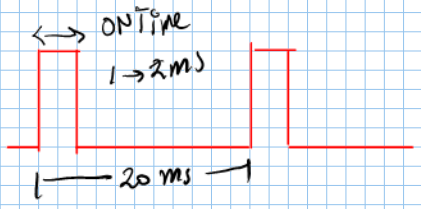
Bit + Adc → resolution

How to choose?

depend on app

- X Position → DC motor + driver + Control Circuit
- degree position
  - > 180 → stepper motor , DC motor
  - < 180 → servo

Servo Calculations



SW PWM

- 0,25 ms
- 20 ms
- 1 ms → system become exclusive interrupt ✗

*How

PWM :

① Fast PWM → Timer0 : Prescaler ① 0 ② 8 ③ 64 ④ 256 ⑤ 1024

① OVF = 255 * 1/8 μsec → 32 μsec

② ovf = 255 * 255/8 μsec ⇒ ≈ 8 ms ✗

③ ovf = 255 * 1024/8 μsec ⇒ ≈ 32,768 ms

→ Timer 1 : Prescaler : ① 0 ② 8

① ovf : 65535 * 1/8 μsec = 8,192 ms

w/ prescaler

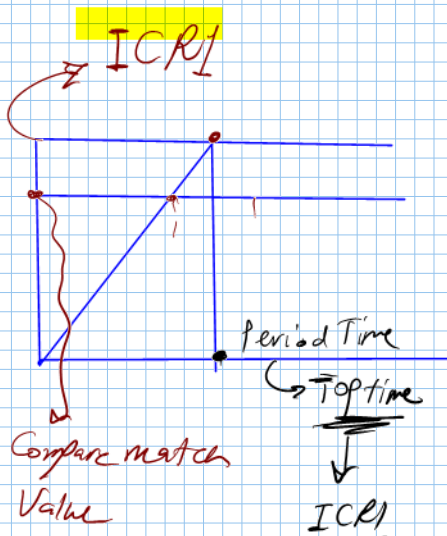
② ovf : 65535 * 8/8 μsec = 65,535 ms

* Timer 1 : 16 bit Counter/timer
  - has 16 mode

Counter Registe: TCNT1 → TCNT1H, TCNT1L

WGM13 , WGM12 , WGM11 , WGM10
1 1 1 0

mode 15 :
- fastPWM



Top value : ICR1 → 16 bit (input Capture Register)

Compare match : OCR1A, OCR2B } 2 channels

ICR1 / ICR1 65536 ex: 255

T = no. of ticks * OVF value

lets get back to servo calc:

assume prescaler : 8 divide

Tick Time = 1 µsec

Periode time = 20 ms = top time = ICR1 * tick time

→ 20ms = ICR1 * 1 µsec

ICR1 = 20000

Duty cycle = OCR1 / OVF time → 0,05 = OCR1 / 20000

* fastPWM: set on Compare clear on top

OCR1 = 1000

1000 → 0°

2000 → 180°