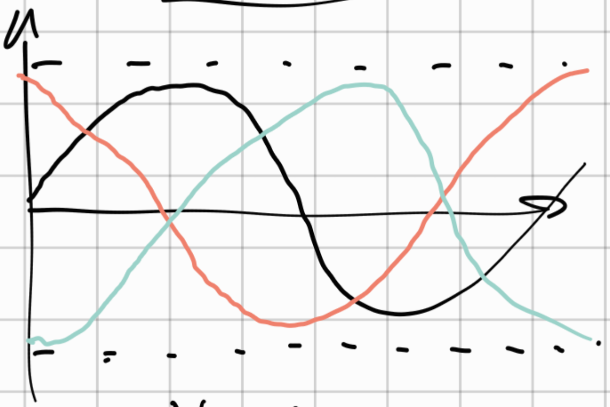
Commutation:

In A-B-C Frame

SPWM:

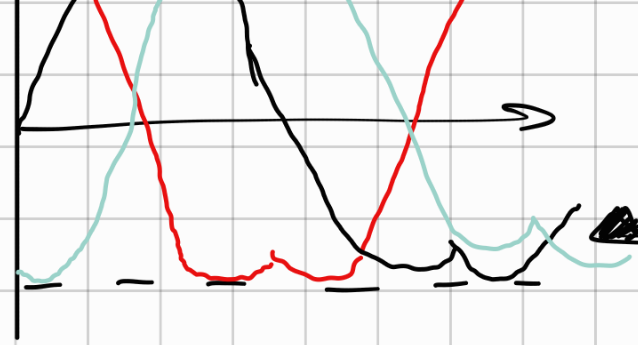


$$I_A = \frac{V_{cmd}}{V_{bus}} \cdot \sin(\theta)$$

$$I_B = \frac{V_{cmd}}{V_{bus}} \cdot \sin(\theta - 120^\circ)$$

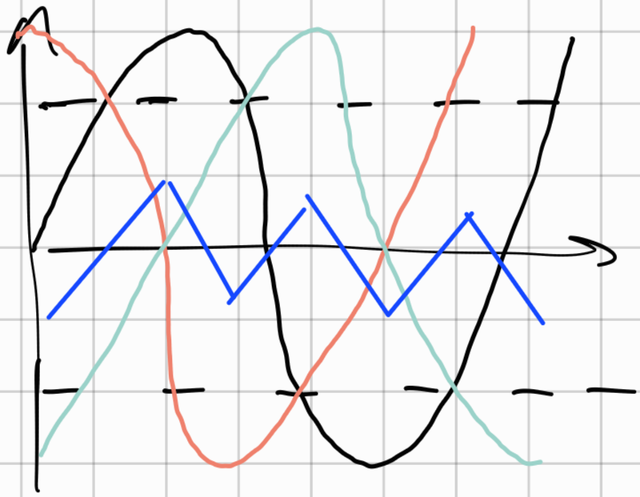
$$I_C = \frac{V_{cmd}}{V_{bus}} \cdot \sin(\theta - 240^\circ)$$

- Not uses the entire Voltage diffrence avidale (use 86.6 %)
- Six step is this but bit-wise (1/0)



SVM:

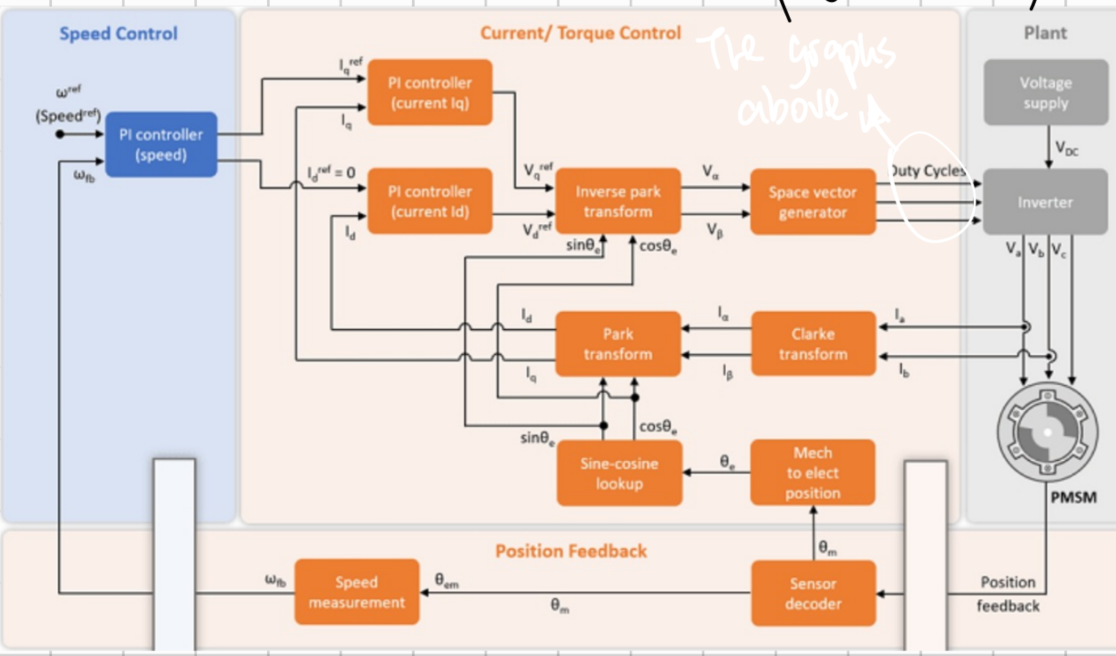
- Take SPWM and increase it by $\frac{1}{86.6\%} = 1.1547$



Then fold the extra (what goes over the line) to fit inside the given voltage.
(By adding a triangle as seen in Blue)
each peak of the triangle is at a point where the voltage goes beyond 100%

Looks something like this

The control scheme: (Overall)



Park:

$$\begin{bmatrix} d \\ q \\ 0 \end{bmatrix} = \frac{2}{3}\begin{bmatrix} S\theta & S(\theta-\frac{2\pi}{3}) & S(\theta+\frac{2\pi}{3}) \\ C\theta & C(\theta-\frac{2\pi}{3}) & C(\theta+\frac{2\pi}{3}) \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{bmatrix}\begin{bmatrix} a \\ b \\ c \end{bmatrix}$$

Inverse Park:

$$\begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} S\theta & C\theta & 1 \\ S(\theta-\frac{2\pi}{3}) & C(\theta-\frac{2\pi}{3}) & 1 \\ S(\theta+\frac{2\pi}{3}) & C(\theta+\frac{2\pi}{3}) & 1 \end{bmatrix}\begin{bmatrix} d \\ q \\ 0 \end{bmatrix}$$

Clarke:

$$\begin{bmatrix} \alpha \\ \beta \\ 0 \end{bmatrix} = \frac{2}{3}\begin{bmatrix} 0 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & \frac{\sqrt{3}}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{bmatrix}\begin{bmatrix} a \\ b \\ c \end{bmatrix}$$

Inverse Clarke:

$$\begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 1 & 0 & 1 \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} & 1 \\ -\frac{1}{2} & -\frac{\sqrt{3}}{2} & 1 \end{bmatrix}\begin{bmatrix} \alpha \\ \beta \\ 0 \end{bmatrix}$$

So this alligned with the graphs above will give me the desired PWM signal...

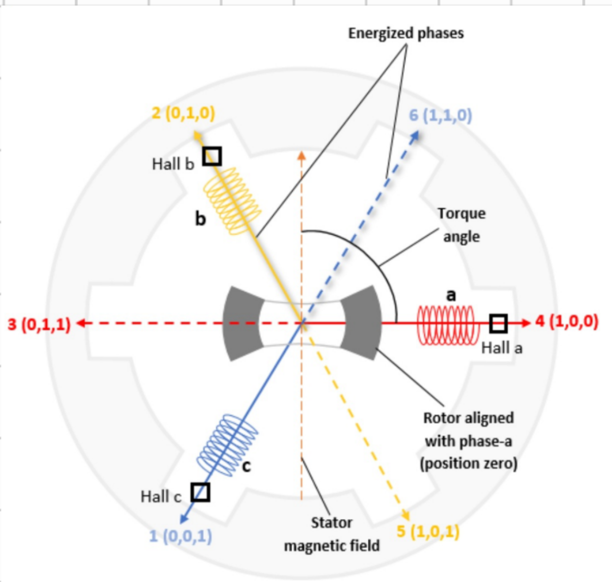
Or, i'm missing something

Electric angle visualization:

$$\boxed{\frac{\theta_e}{\theta_m} = N_{pp}}$$

→ So if commutating its easier the rotor angle by the N_{pp} and take the Modulo.

Then the sections are as follows



PWM Idea:

PWM Period
- on
  - T_1
  - T_2
- off (T_0)

T_1: Closest in clock wise dir.

T_2: Closesit in CCW dir.

T_0: Null between them ([0,0,0], [1,1,1]) choose to make as least possible switches.

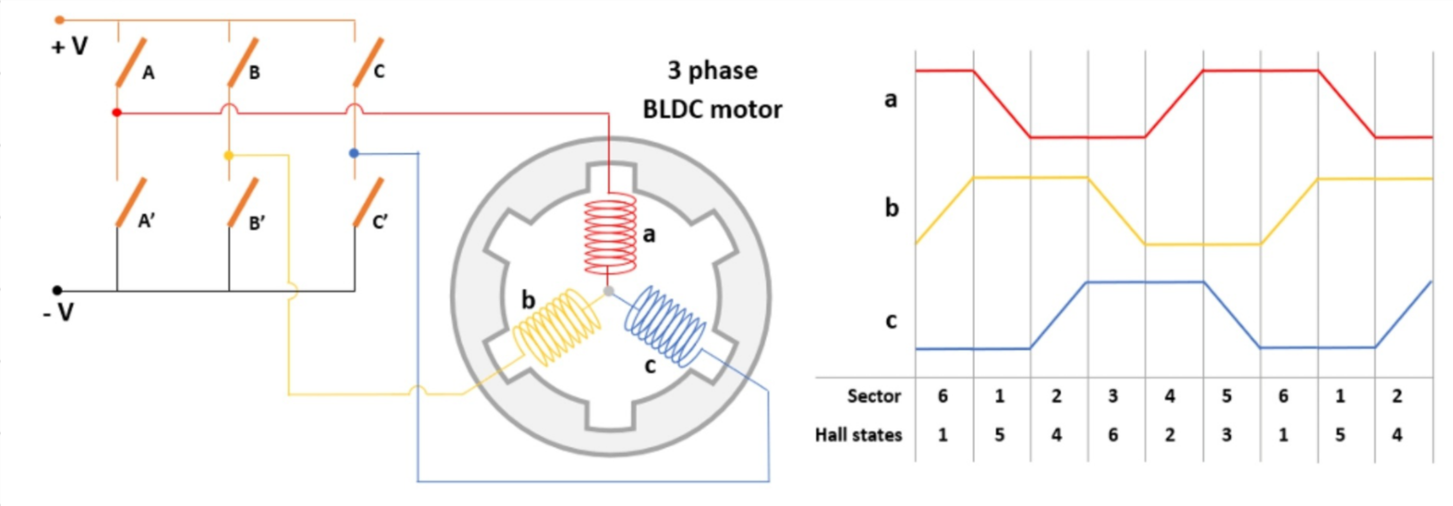
$T_1 : T \cdot DC \cdot \sin(60-\theta)$

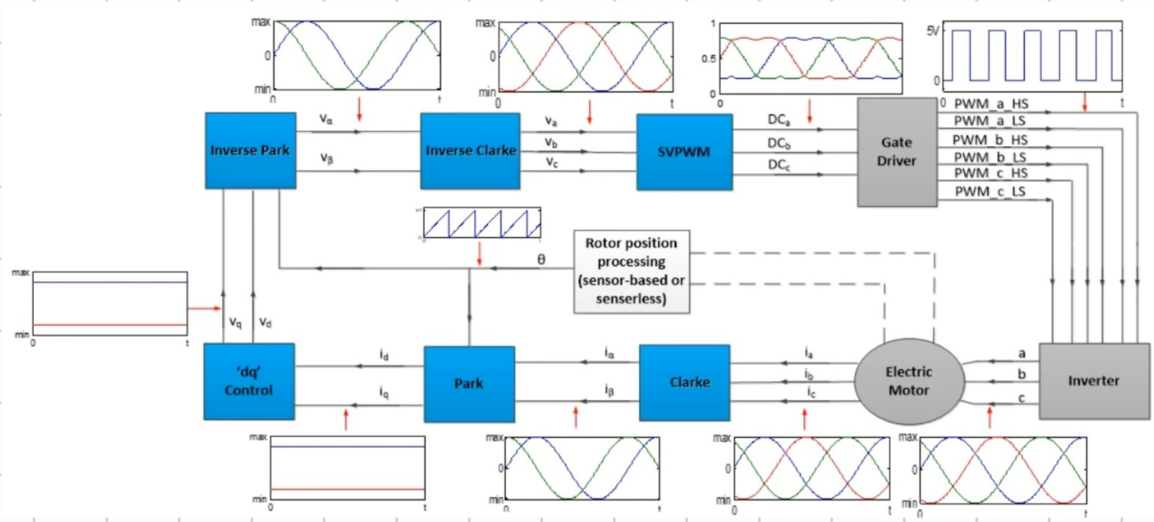
$T_2 : T \cdot DC \cdot \sin(\theta)$

$T_0 : T - T_1 - T_2$,

T = Time Period

DC = Duty cycle





so the triangle wave drops it.

$V_{Bus} = 100$ [V]