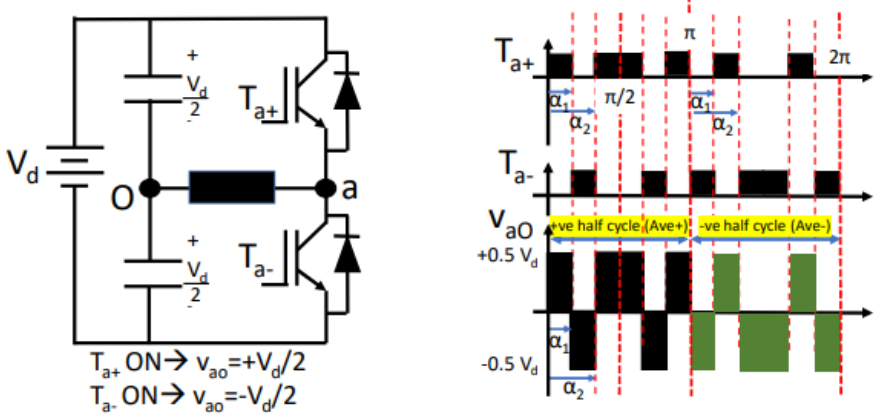
Selective Harmonic Elimination (SHE)

Bipolar Selective Harmonic Elimination (SHE):

Selective Harmonics Elimination is a groundbreaking technique used in power electronics, especially in inverters. It involves strategically eliminating specific harmonics from the output waveform to enhance overall performance. This code provides the essential angles required for precise harmonics elimination.

Assume the bipolar output voltage (v_{aO}) is generated from half-bridge inverter as follows:

for 2 angles (α_1 , α_2) :



The Fourier analysis for the shown output voltage is given by:

$$V_{pn}=\frac{2V_d}{n\pi}[1-2\cos n\alpha_1+2\cos n\alpha_2]$$

so by this equation, I can control the fundamental voltage and eliminate any specific harmonic I want by getting the **α_1 , α_2**.

For example: To achieve certain fundamental voltage magnitude (=A) and eliminate one component of the harmonic components (let it 3rd harmonic).

$$V_{p1}=\frac{2V_d}{\pi}[1-2\cos\alpha_1+2\cos\alpha_2]=A,$$

i.e. $\frac{2V_d}{\pi}[1-2\cos\alpha_1+2\cos\alpha_2]-A=0$ ----(1)

To eliminate 3rd harmonic→ V_{p3} should =0, i.e.

$$V_{p3}=\frac{2V_d}{3\pi}[1-2\cos 3\alpha_1+2\cos 3\alpha_2]=0 \text{ -----(2)}$$

By solving Eqs (1) and (2) , suitable values of α_1 and α_2 can be estimated.

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How to get those angles?

By Using the **Newton Raphson method** to get angles

If f(x)=0, find x=?

Assume initial guess of x=xo

1 st iteration $x_1 = x_o - [f(x_o)/f'(x_o)]$

2 nd iteration $x_2 = x_1 - [f(x_1)/f'(x_1)]$

3 rd iteration $x_3 = x_2 - [f(x_2)/f'(x_2)]$

Example: f(x)=x2 -4x-7=0 , find x=? Assume x_o =5

Solution: f'(x)=2x-4

x_1=5-[(5 2 -4(5)-7)/(2(5)-4)]=5.33

x_2=5.33-[(5.332 -4(5.33)-7)/(2(5.33)-4)]=5.3166 ..... etc

Make it formative:

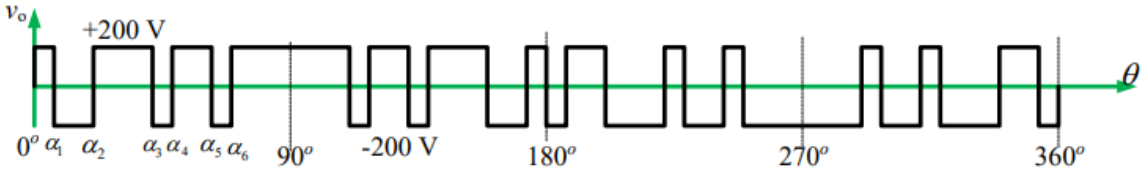
→ 1st iteration

$$\begin{bmatrix} x_1 \\ y_1 \end{bmatrix} = \begin{bmatrix} x_o \\ y_o \end{bmatrix} - ([J]^{-1})_{x_o,y_o} \begin{bmatrix} f_1(x_o, y_o) \\ f_2(x_o, y_o) \end{bmatrix}$$

$$[J] = \begin{bmatrix} \frac{\partial f_1}{\partial x} & \frac{\partial f_1}{\partial y} \\ \frac{\partial f_2}{\partial x} & \frac{\partial f_2}{\partial y} \end{bmatrix}$$

So if it was 6 angles:

$\alpha_{1(0)}$	$\alpha_{2(0)}$	$\alpha_{3(0)}$	$\alpha_{4(0)}$	$\alpha_{5(0)}$	$\alpha_{6(0)}$
20°	30°	40°	50°	60°	70°



Follow my code (:

https://github.com/AlyMustafa/Selective-Harmonic-Elimination