National Institute of Technology, Gifu College
Electrical and Computer Engineering
by T.Tokoro

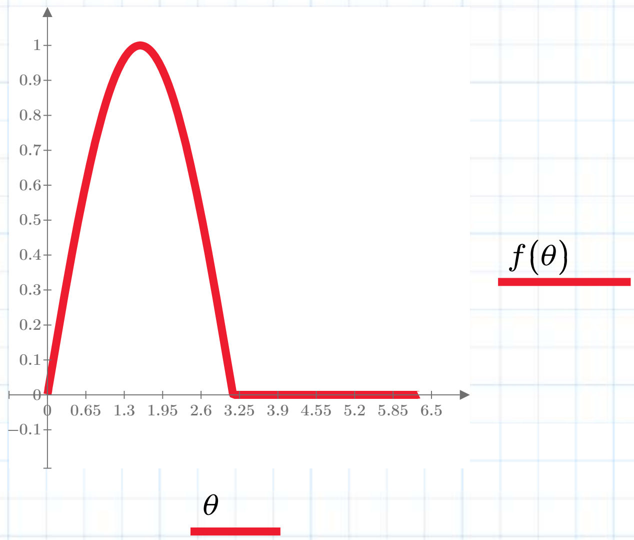
Ex.F7 Fourier-Analysis (Root mean squared value and average value of harf waves)

$Em := 1\ V$ $\quad f := 50\ Hz$ $\quad \phi := 0\ deg$ $\quad \omega := 2 \cdot \pi \cdot f$

$m := 100$ m: Number of harmonics

$\theta := 0, 0.01 .. 2\ \pi$

$$f(\theta) := \frac{1}{\pi} + \sum_{n=1}^{m} \left(\frac{2}{\pi} \frac{-1}{(2 \cdot n)^2 - 1} \cdot \cos(2 \cdot n \cdot (\theta + \phi)) \right) + \frac{1}{2} \sin(\theta + \phi)$$



$E_0 := \frac{1}{\pi}$ $\qquad E_1 := \frac{1}{\sqrt{2} \cdot 2}$

$$E_n := \frac{2}{\sqrt{2} \cdot \pi} \cdot \frac{1}{(2 \cdot n)^2 - 1}$$

$$E := \sqrt{E_0{}^2 + E_1{}^2 + \sum_{n=1}^{\infty} (E_n)^2} \xrightarrow{simplify} \frac{1}{2}$$

$$E_a := \frac{1}{\pi} + \frac{1}{2} \cdot \frac{2}{\pi} \cdot 0 + \sum_{n=1}^{\infty} \left(E_n \cdot \frac{2}{\pi} \right) \cdot 0 \rightarrow \frac{1}{\pi}$$

$$\sum_{n=1}^{100} \left(\int_0^{2 \cdot \pi} \cos(2 \cdot n \cdot (\theta + \phi))\, d\theta \right) \rightarrow 0$$

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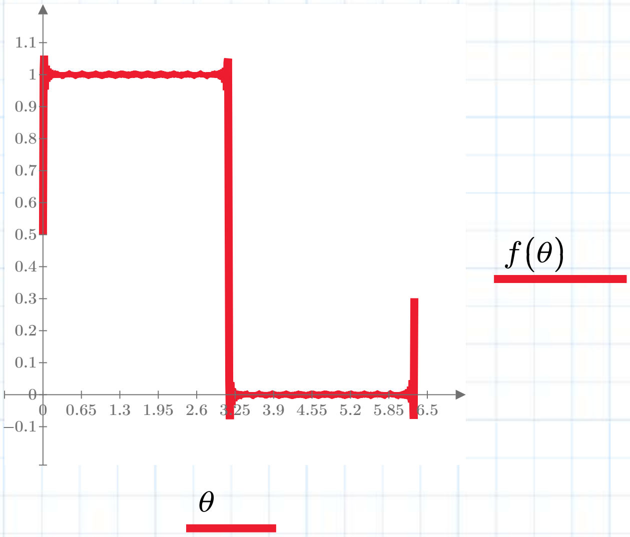
$$f(\theta) := \sum_{n=1}^{m} \left(\frac{2}{\pi} \frac{1}{(2 \cdot n - 1)} \cdot \sin\left((2\ n - 1) \cdot (\theta + \phi)\right) \right) + \frac{1}{2}$$



$$E_0 := \frac{1}{2}$$

$$E_n := \frac{2}{\sqrt{2} \cdot \pi} \frac{1}{(2 \cdot n - 1)}$$

$$E := \sqrt{{E_0}^2 + \sum_{n=1}^{\infty} (E_n)^2} \xrightarrow{simplify} \frac{\sqrt{2}}{2}$$

$$E_a := \frac{1}{2} + \sum_{n=1}^{\infty} (E_n \cdot 0) \rightarrow \frac{1}{2}$$

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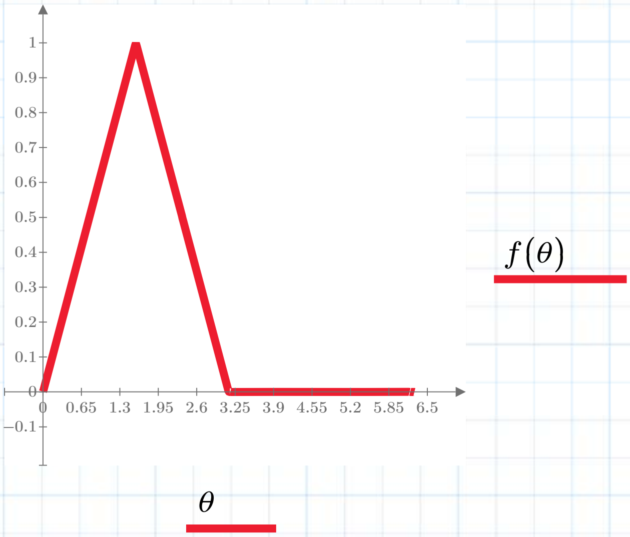
$$f(\theta) := \frac{1}{4} + \frac{2}{\pi^2} \cdot \left(\sum_{n=1}^{m} \left(\frac{-\cos(2 \cdot (2\,n-1) \cdot (\theta+\phi))}{(2 \cdot n-1)^2} \right) \right) + \frac{4}{\pi^2} \cdot \left(\sum_{n=1}^{m} \left(\frac{-(-1)^n \cdot \sin((2 \cdot n-1) \cdot (\theta+\phi))}{(2 \cdot n-1)^2} \right) \right)$$



$$E_0 := \frac{1}{4} \qquad E_n := \frac{2}{\sqrt{2} \cdot \pi^2} \cdot \left(\frac{1}{(2 \cdot n-1)^2} \right)$$

$$E_{n2} := \frac{4}{\sqrt{2} \cdot \pi^2} \cdot \left(\frac{1}{(2 \cdot n-1)^2} \right)$$

$$E := \sqrt{{E_0}^2 + \sum_{n=1}^{\infty} (E_n)^2 + \sum_{n=1}^{\infty} (E_{n2})^2} \xrightarrow{simplify} \frac{\sqrt{6}}{6}$$

$$E_a := \frac{1}{4} + \sum_{n=1}^{\infty} (E_n + E_{n2}) \cdot 0 \rightarrow \frac{1}{4}$$