Xilinx Zynq FPGA, TI DSP, MCU 기반의 프로그래밍 및 회로 설계 전문가 과정

#60

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푸리에 급수

(함수단위의 직교화)

$\langle f(x), g(x) \rangle = \int_a^b f(x)g(x)dx = 0.$

↳ 직교한다.

$\langle f(x), g(x) \rangle = \int_{-\pi}^{\pi} \sin(x)\sin(2x)dx.$

$e^{ix} = \cos x + i\sin x$

$* \sin x = \frac{e^{ix}-e^{-ix}}{2i}, \quad \cos x = \frac{e^{ix}+e^{-ix}}{2}$

$-\frac{1}{4}\int_{-\pi}^{\pi} (e^{ix}-e^{-ix})(e^{2ix}-e^{-2ix})dx$

$-\frac{1}{4}\int_{-\pi}^{\pi} e^{3ix}-e^{-ix}-e^{ix}+e^{-3ix}\,dx$

$-\frac{1}{4}\int_{-\pi}^{\pi} \left(e^{3ix}+e^{-3ix}-(e^{ix}+e^{-ix})\right)dx$

$= \int_{-\pi}^{\pi} \frac{\cos x - \cos 3x}{2}dx$

cos의 주기적분 $=0$.

$=0$ 서로 직교한다.

*푸리에 시리즈를 이용하여 펄스파 생성

$f(x)_{-\pi \le x < 0} = 0$

$f(x)_{0 \le x < \pi} = 1$

$a_0 = \int_{-\pi}^{\pi} f(x)dx = \int_{-\pi}^{0} 0\,dx + \int_0^{\pi} 1\,dx = 1$

$a_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\cos(\frac{n\pi}{T}x)dx = \int_{-\pi}^{0} \cancel{0\cos x}^{\,0} + \int_0^{\pi}\cos(\frac{n\pi}{T}x)dx$

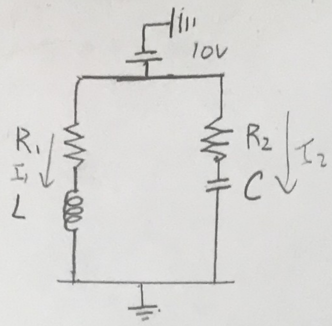
$= \frac{1}{\pi}\left[\frac{T}{n\pi}\sin(\frac{n\pi}{T}x)\right]_0^{\pi} = 0.$

$b_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\sin(\frac{n\pi}{T}x)dx = \frac{1}{\pi}\left[-\frac{T}{n\pi}\cos(\frac{n\pi}{T}x)\right]_0^{\pi}$

$= \frac{1}{\pi}\left(+\frac{T}{n\pi}+\frac{T}{n\pi}\right) = \frac{2T}{n\pi^2}$

$\therefore f(x) = \frac{1}{2} + \sum_{n=1}^{\infty} \int \frac{2}{n\pi}\sin(\frac{n\pi}{T}x)dx.$

라플라스 변환을 활용한 예



$V_L = L\frac{di}{dt}$

$i_c = C\frac{dV}{dt} \Rightarrow V_c = \frac{1}{C}\int i\,dt$

1. $10 = i_1R_1 + L\dot{i}_1$
2. $10 = i_2R_2 + \frac{1}{C}\int i_2\,dt$

$\frac{10}{s} = I_1(s)R_1 + L\{sI(s) - i(0)\}$

$\frac{10}{s} = I_2(s)R_2 + \frac{1}{C}\frac{1}{s}I_2(s)$

$10 = sI_1(s)R_1 + Ls^2I_1(s)$

$10 = sI_2(s)R_2 + \frac{1}{C}I_2(s)$

$I_1(s) = \frac{10}{Ls\{(s+\frac{R_1}{2L})^2 - \frac{R_1^2}{4L^2}\}}$

$\mathcal{L}^{-1}\{\cos(\omega t)\} = \frac{\omega}{s^2-\omega^2}$

$\omega = \frac{R_1}{2L}$ 그러므로 계수는 $\frac{2L}{R_1}10$

$\frac{2L}{R_1}\times\frac{(\frac{R_1}{2L})}{(s+\frac{R_1}{2L})^2 - (\frac{R_1}{2L})^2}\cdot\frac{1}{L}$

$i_1(t) = \frac{20}{R_1}\cosh(\frac{R_1}{2L}t)e^{-\frac{R_1}{2L}t}$

$V_L(t) = \frac{R_1}{2L}\times\frac{20}{R_1} = \frac{10}{L}\sinh(\frac{R_1}{2L}t)e^{-\frac{R_1}{2L}t} - \frac{R_1}{2L}\frac{20}{R_1}\cosh(\frac{R_1}{2L}t)e^{-\frac{R_1}{2L}t}$

$I_2(s) = \frac{10C}{sR_2C+1} = \frac{10C}{R_2C(s+\frac{1}{R_2C})} = \frac{10}{R_2}\cdot\frac{1}{(s+\frac{1}{R_2C})}$

$i_2(t) = \frac{10}{R_2}\cdot e^{-\frac{t}{R_2C}}$

$10 = I_1(s)(sR_1 + Ls^2)$

$I_1(s) = \frac{10}{(sR_1+Ls^2)}$

$10 = I_2(s)(sR_2+\frac{1}{C})$

$I_2(s) = \frac{10}{sR_2+\frac{1}{C}} = \frac{10C}{sR_2C+1}$

$I_1(s) = \frac{10}{(sR_1+Ls^2)} = \frac{10}{L(s^2+\frac{R_1}{L}s)}$

$(s+\frac{R_1}{2L})^2 - \frac{R_1^2}{4L^2}$