TI DSP, MCU, Xilinx Zynq FPGA 프로그래밍 전문가 과정

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라플라스 변환의 정의식

$$F(s)=\mathcal{L}(f)=\int_0^\infty e^{-st}f(t)dt$$

라플라스 변환 선형성

$$\mathcal{L}\{(af(t)+bg(t)\}=a\mathcal{L}\{f(t)\}b\mathcal{L}\{g(t)\}$$

정의식에 대입하면

$$\mathcal{L}\{af(t)+bg(t)\}=\int_0^\infty e^{-st}[\ af(t)+bg(t)]$$
$$=a\int_0^\infty e^{-st}f(t)dt+b\int_0^\infty e^{-st}g(t)dt$$
$$=a\mathcal{L}\{f(t)\}+b\mathcal{L}\{g(t)\}$$

제 1이동 정리

식

$F(s)=\mathcal{L}(f)=\int_0^\infty e^{-st}f(t)dt$ 에서 s를 s-a로 두면

$$F(s-a)=\int_0^\infty e^{-(s-a)t}f(t)dt$$
$$=\int_0^\infty e^{-st}[\ e^{at}f(t)]\ dt$$
$$=\mathcal{L}\{e^{at}f(t)\}$$

f(t)도함수의 라플라스변환

$$\mathcal{L}(f')=s\mathcal{L}(f)-f(0)$$
$$\mathcal{L}(f')=\int_0^\infty e^{-st}f'(t)dt$$
$$=[\ e^{-st}f(t)]\ _0^\infty+s\int_0^\infty e^{-st}f(t)dt$$

n계 도함수의 경우

$$\mathcal{L}(f^{(n)})=s^n\mathcal{L}(f)-s^{n-1}f(0)-s^{n-2}f'(0)-\ \dots-f^{(n-1)}(0)$$

$$\mathcal{L}(f'')=s\mathcal{L}(f')-f'(0)$$
$$=s[\ s\mathcal{L}(f)-f(0)]\ -f'(0)$$
$$=s^2\mathcal{L}(f)-sf(0)-f'(0)$$

$\mathcal{L}(f''')$인 경우에도 위와 같이 전개 되며,
귀납법을 이용하여 증명.

Entry No.	$f(t) = \frac{1}{2\pi j}\int_{\sigma - j\infty}^{\sigma + j\infty} F(s)e^{st}\,ds$	$F(s) = \int_0^{\infty} f(t)e^{-st}\,dt$
1	$\delta(t)$	1
2	$u(t)$	$\frac{1}{s}$
3	t^n for $n > 0$	$\frac{n!}{s^{n+1}}$
4	e^{-at}	$\frac{1}{s+a}$
5	te^{-at}	$\frac{1}{(s+a)^2}$
6	$\frac{t^{n-1}e^{-at}}{(n-1)!}$	$\frac{1}{(s+a)^n}$
7	$\frac{1}{b-a}(e^{-at} - e^{-bt}) \quad a \neq b$	$\frac{1}{(s+a)(s+b)}$
8	$-\frac{1}{b-a}(ae^{-at} - be^{-bt}) \quad a \neq b$	$\frac{s}{(s+a)(s+b)}$
9	$\sin \omega t$	$\frac{\omega}{s^2 + \omega^2}$
10	$\cos \omega t$	$\frac{s}{s^2 + \omega^2}$
11	$e^{-at} \sin \omega t$	$\frac{\omega}{(s+a)^2 + \omega^2}$
12	$e^{-at} \cos \omega t$	$\frac{s+a}{(s+a)^2 + \omega^2}$
13	$\sinh \omega t$	$\frac{\omega}{s^2 - \omega^2}$
14	$\cosh \omega t$	$\frac{s}{s^2 - \omega^2}$
15	$\frac{\sqrt{a^2 + \omega^2}}{\omega} \sin(\omega t + \varphi),\ \varphi = \tan^{-1} \frac{\omega}{a}$	$\frac{s+a}{s^2 + \omega^2}$

(continued)