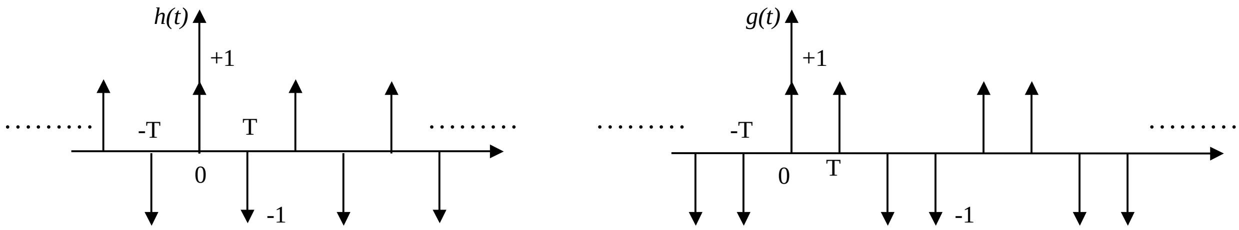
數位信號處理導論 (DSP) 2021/10/01
Homework #2 Due: Oct. 08, 2021 (Friday)

Impulse Function, $\delta(t)$, and its Fourier Transform

1. As shown in the figures, *h(t)* and *g(t)* are both *infinite impulse function trains*. Please determine the Fourier Transform pairs of *h(t)* and *g(t)* function. You may use the Linearity and Time Shifting properties of Fourier Transform.

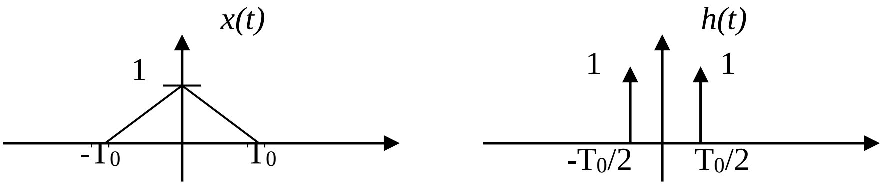


2. A function *h(t)* is defined as $h(t)=\begin{cases} A\cdot\cos(2\pi f_o t), & for\ |t|<T \\ 0, & for\ |t|>T \end{cases}$, (a). please show that the Fourier transform of *h(t)* in *f*-domain is $H(f)=A^2\cdot T\cdot[Q(f+f_o)+Q(f-f_o)]$, where $Q(f)=\dfrac{\sin(2\pi Tf)}{2\pi Tf}$, (b) please plot the functions of *h(t)* and *H(f)* for the cases of $f_o\cdot T$ =10, 100, and 1000. (c). what happens to *H(f)* if $f_o\cdot T\to\infty$

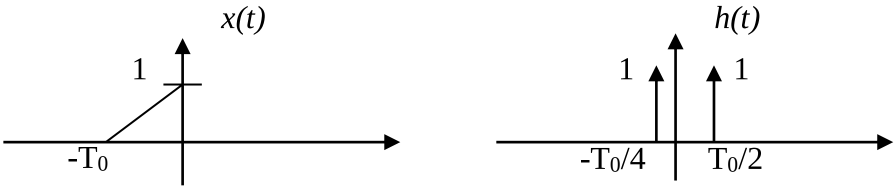
Convolution and convolution theory

3. Please determine and plot the convolution of *x(t)* and *h(t)*

(a)



(b)

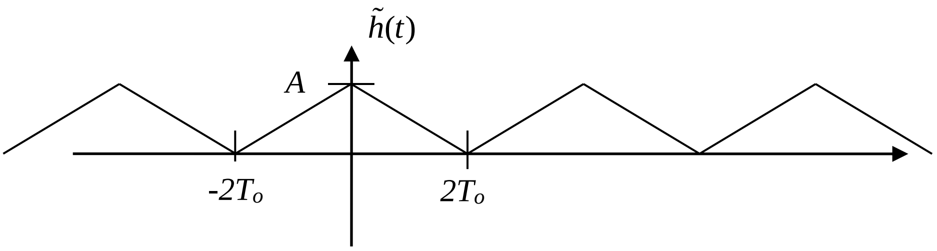


4. Prove the frequency convolution theory, i.e., if { *x(t), X(f)* } and { *h(t), H(f)* } are Fourier transform pairs, then { *x(t)h(t), X(f)*H(f)* } is also a Fourier transform pair.

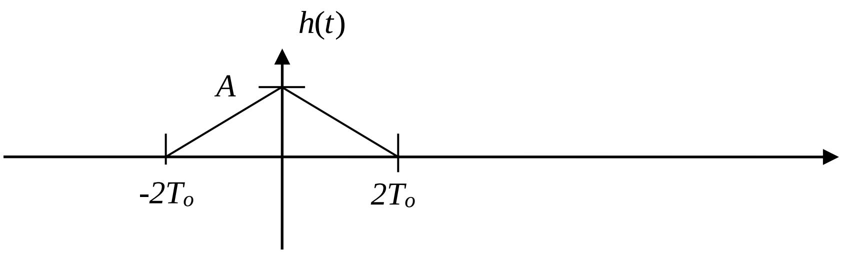
5. Show that $[f(t)*g(t)]*h(t)=f(t)*[g(t)*h(t)]$

Relation between Fourier Integration Transform (FT) and Fourier Series Expansion (FS)

6. (a). As shown in the figure, please determine the Fourier Series Expansion (FS) of a periodic function $\tilde{h}(t)$



(b). As shown in the figure, please determine the Fourier transform (FT) of a non-periodic function $h(t)$



(c). Can you derive and verify the relationship between the Fourier transform of $h(t)$ and the Fourier series coefficient of $\tilde{h}(t)$