Graphical approach to convolution

Input functions

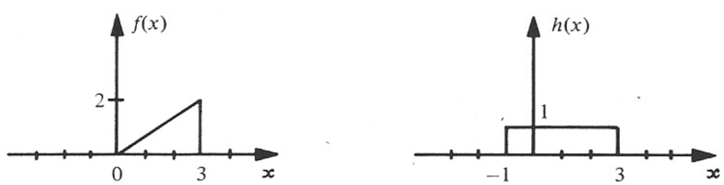


Figure 6-1 Functions used to illustrate convolution by graphical methods.

output

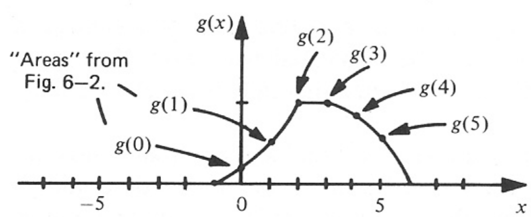


Figure 6-3 Resulting convolution of functions shown in Fig. 6-1.

Graphical view

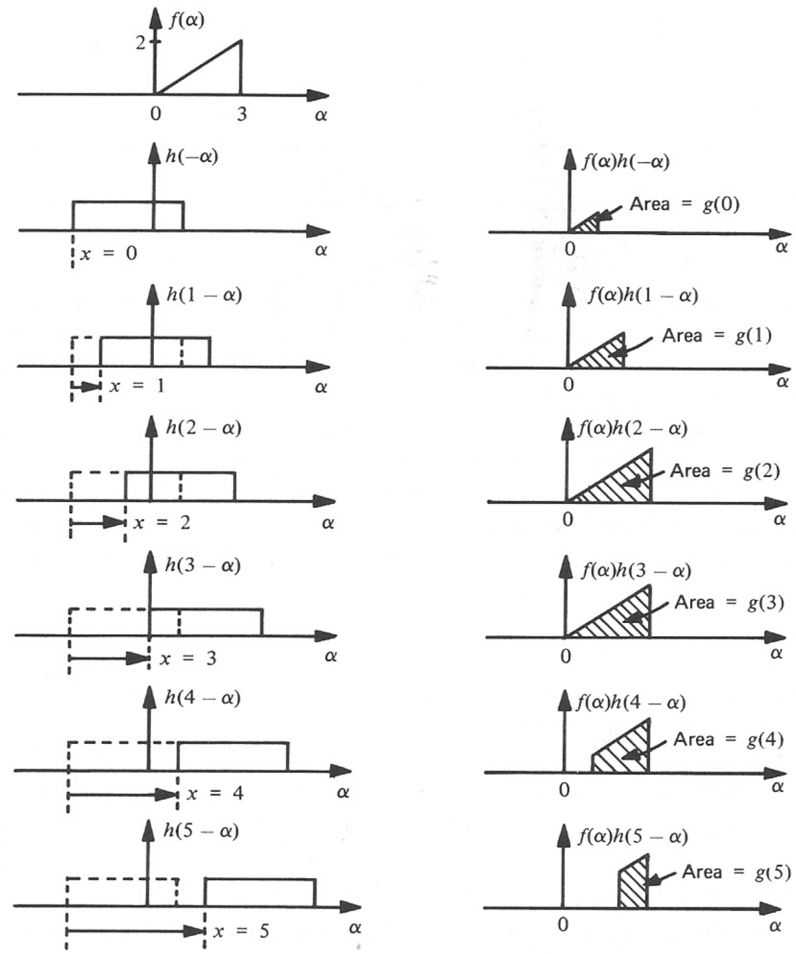


Figure 6-2 Graphical method for convolving functions of Fig. 6-1.

Smoothing effects

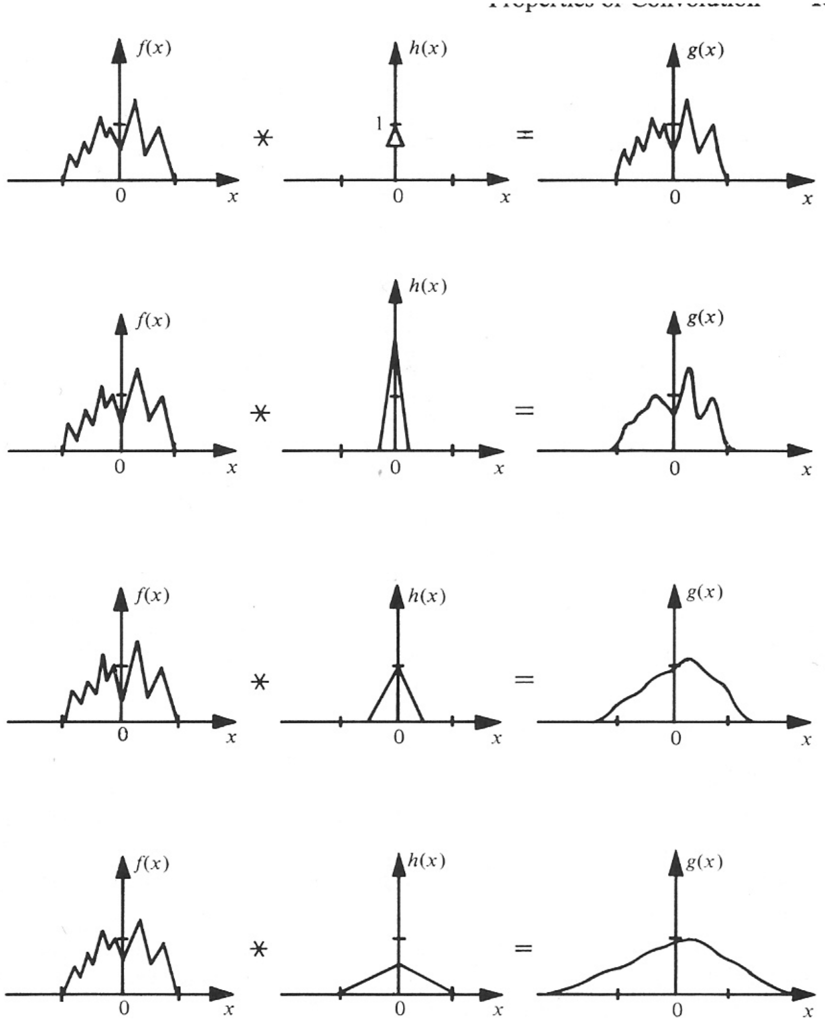


Figure 6-5 Smoothing effects of convolution.

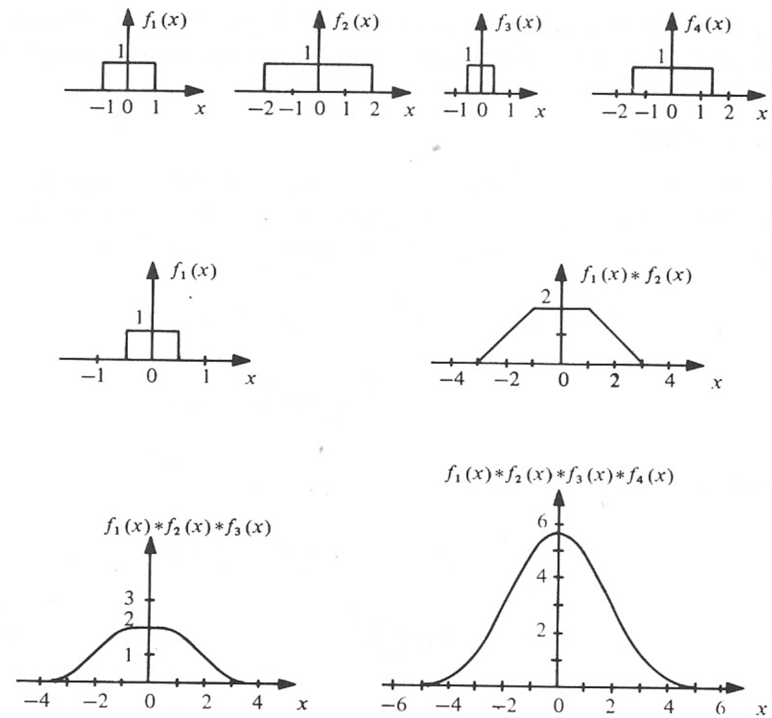


Figure 6-7 Repeated convolution of four rectangle functions.

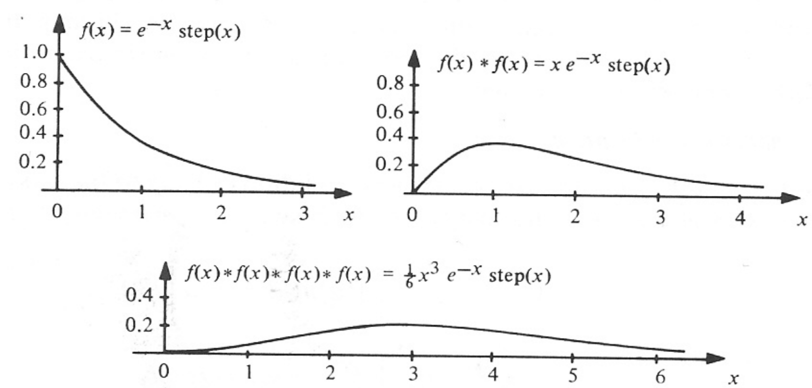
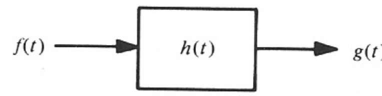


Figure 6-8 Repeated convolution of the function $\exp\{-x\}\mathrm{step}(x)$.

Impulse response of an LSI system



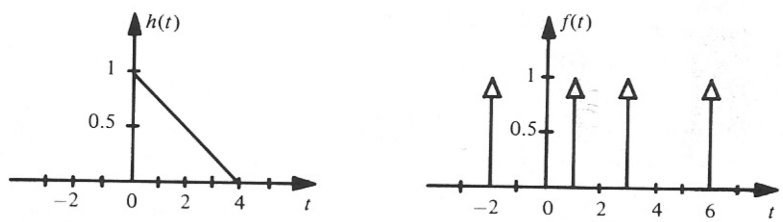
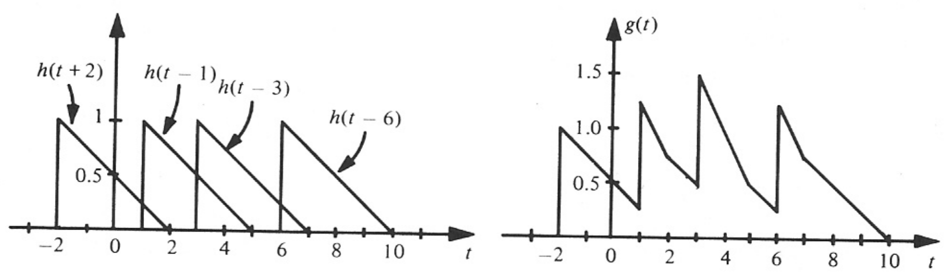


Figure 6-9 An example involving a linear shift invariant system.



(a)

(b)

Figure 6-10 Output of system shown in Fig. 6-9. (*a*) Responses to individual input delta functions. (*b*) Overall response to combined input delta functions.

Symmetry properties of FT

Symmetry Properties of Fourier Transforms

$f(x)$	$F(\xi)$
Complex, no symmetry	Complex, no symmetry
Hermitian	Real, no symmetry
Antihermitian	Imaginary, no symmetry
Complex, even	Complex, even
Complex, odd	Complex, odd
Real, no symmetry	Hermitian
Real, even	Real, even
Real, odd	Imaginary, odd
Imaginary, no symmetry	Antihermitian
Imaginary, even	Imaginary, even
Imaginary, odd	Real, odd

FT theorems

Properties of Fourier Transforms

A_1 and A_2 arbitrary constants
b and d real nonzero constants

x_0 and ξ_0 real constants
k a positive integer

$g(x)=\int_{-\infty}^{\infty} G(\beta)e^{j2\pi\beta x}d\beta$	$G(\xi)=\int_{-\infty}^{\infty} g(\alpha)e^{-j2\pi\alpha\xi}d\alpha$	
$f(\pm x)$	$F(\pm\xi)$	
$f^*(\pm x)$	$F^*(\mp\xi)$	
$F(\pm x)$	$f(\mp\xi)$	
$F^*(\pm x)$	$f^*(\pm\xi)$	
$f\left(\frac{x}{b}\right)$	$\lvert b\rvert F(b\xi)$	**scaling**
$\lvert d\rvert f(dx)$	$F\left(\frac{\xi}{d}\right)$	
$f(x\pm x_0)$	$e^{\pm j2\pi x_0\xi}F(\xi)$	**shift**
$e^{\pm j2\pi\xi_0 x}f(x)$	$F(\xi\mp\xi_0)$	