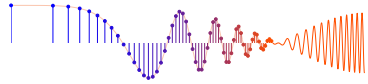

Example 11-14: Finite-Length Sinusoid

As an example of the use of (11.93), suppose that $x(t)$ is the rectangular pulse signal $x(t) = [u(t+T/2) - u(t-T/2)]$, which has Fourier transform

$$X(j\omega) = \frac{\sin(\omega T/2)}{(\omega/2)}$$

Then if we form the signal $y(t) = x(t)\cos(\omega_0 t)$, by (11.93) the corresponding Fourier transform is

$$\begin{aligned} Y(j\omega) &= \tfrac{1}{2}X(j(\omega-\omega_0)) + \tfrac{1}{2}X(j(\omega+\omega_0)) \\ &= \frac{\sin((\omega-\omega_0)T/2)}{(\omega-\omega_0)} + \frac{\sin((\omega+\omega_0)T/2)}{(\omega+\omega_0)} \end{aligned}$$

Figure 11-17(a) shows the product signal $y(t)$ and Fig. 11-17(b) shows the corresponding Fourier transform. Since $X(j\omega)$ is approximately bandlimited to low frequencies, the pulse modulated cosine wave has a Fourier transform that is concentrated near $\pm\omega_0$. The locations of the shifted copies of $X(j\omega)$ are indicated in Fig. 11-17(b). ■

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