Example 11-9: Rational Fourier Transform

To illustrate how a known transform pair (from Table 11-2 on p. 11-2 can be used to find the frequency response given the impulse response, suppose that

$$h(t) = 2e^{-2t}u(t) - e^{-t}u(t) \tag{11.59}$$

We know the transform of the one-sided exponential, so linearity gives the result as two terms

$$H(j\omega) = \frac{2}{2 + j\omega} - \frac{1}{1 + j\omega} \tag{11.60a}$$

$$= \frac{j\omega}{(2 + j\omega)(1 + j\omega)} \tag{11.60b}$$

Likewise, if we wanted to start with $H(j\omega)$ and obtain $h(t)$, we could easily do so when $H(j\omega)$ is given in the form of (11.60a) by using the right-sided exponential entry in Table 11-2 on p. 11-2 to go from the frequency-domain to the time-domain. However, if $H(j\omega)$ is given in the form of (11.60b) we would first need to put it into the form of (11.60a). We show in Section 11-6.3.3 how to do this using the method of partial fraction expansion. ■