- The Magnitude-Phase Representation of the Fourier Transform
- The Magnitude-Phase Representation of Frequency Response of LTI Systems
- Time-Domain Properties of Ideal Frequency-Selective Filters (p.439)
- Time-Domain and Frequency-Domain Aspects of Non-ideal Filters (p.444)
- 1st-Order & 2nd-Order Continuous-Time Systems
- 1st-Order & 2nd-Order Discrete-Time Systems
- Time- & Frequency-Domain Analysis of Systems

(p.472)

6.7: Lowpass Filter: Passband, Stopband, Ripple

6.7. A continuous-time lowpass filter has been designed with a passband frequency of 1,000 Hz, a stopband frequency of 1,200 Hz, passband ripple of 0.1, and stopband ripple of 0.05. Let the impulse response of this lowpass filter be denoted by $h(t)$. We wish to convert the filter into a bandpass filter with impulse response

$$g(t) = 2h(t)\cos(4{,}000\pi t).$$

Assuming that $|H(j\omega)|$ is negligible for $|\omega| > 4{,}000\pi$, answer the following questions:

(a) If the passband ripple for the bandpass filter is constrained to be 0.1, what are the two passband frequencies associated with the bandpass filter?

(b) If the stopband ripple for the bandpass filter is constrained to be 0.05, what are the two stopband frequencies associated with the bandpass filter?

6.33: Highpass Lowpass Filters

6.33. Figure P6.33 shows a system commonly used to obtain a highpass filter from a lowpass filter and vice versa.

(a) Show that, if $H(j\omega)$ is a lowpass filter with cutoff frequency ω_{lp}, the overall system corresponds to an ideal highpass filter. Determine the system's cutoff frequency and sketch its impulse response.

(b) Show that, if $H(j\omega)$ is an ideal highpass filter with cutoff frequency ω_{hp}, the overall system corresponds to an ideal lowpass filter, and determine the cutoff frequency of the system.

(c) If the interconnection of Figure P6.33 is applied to an ideal discrete-time lowpass filter, will the resulting system be an ideal discrete-time highpass filter?

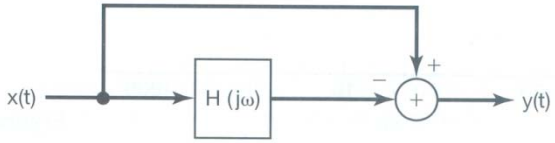

Figure P6.33

6.47: 3-Point Moving Average

6.47. A three-point symmetric moving average, referred to as a weighted moving average, is of the form

$$y[n] = b\{ax[n-1] + x[n] + ax[n+1]\}. \qquad \text{(P6.47–1)}$$

(a) Determine, as a function of a and b, the frequency response $H(e^{j\omega})$ of the three-point moving average in eq. (P6.47–1).

(b) Determine the scaling factor b such that $H(e^{j\omega})$ has unity gain at zero frequency.

(c) In many time-series analysis problems, a common choice for the coefficient a in the weighted moving average in eq. (P6.47–1) is $a = 1/2$. Determine and sketch the frequency response of the resulting filter.