

Lecture 21: Frequency Domain Convolution Examples

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1 Frequency Domain Convolution Examples

2 Summary

Outline

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Frequency Domain Convolution

Remember that the Fourier transform of windowing is convolution in frequency:

$$h[n] = w[n]h_i[n] \leftrightarrow H(\omega) = \frac{1}{2\pi} H_i(\omega) * W(\omega),$$

where

$$H_i(\omega) * W(\omega) = \int_{-\pi}^{\pi} H_i(\theta) W(\omega - \theta) d\theta$$

Ideal LPF Convolved in Frequency with the DTFT of a Rectangular Window

Ideal LPF Convolved in Frequency with the DTFT of a Hamming Window

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- The sidelobes of the Hamming window are tiny, therefore the stop-band ripple of the Hamming-windowed filter is tiny.
- The filter's transition band equals the main-lobe width of the window spectrum, which is $2 \times \frac{2\pi}{N} = \frac{4\pi}{N}$ for the rectangular window, $2 \times \frac{4\pi}{N} = \frac{8\pi}{N}$ for the Hamming window.