Example 7-7: One property of the transition width is that it can be controlled by changing the filter order. There is an approximate inverse relationship, so doubling the order reduces the transition width by roughly one half. We can test this idea on the length-25 rectangular window LPF in Fig. **??**(b) which has an order equal to 24. If we design a new LPF that has the same cutoff frequency, $\hat{\omega}_{\text{co}} = 0.4\pi$, but twice the order (i.e., $M = 48$), then we can repeat the measurement of the bandedges $\hat{\omega}_p$, $\hat{\omega}_s$, and the transition width $\Delta\hat{\omega}$.

Filter	Order: M	$\hat{\omega}_p$	$\hat{\omega}_s$	$\Delta\hat{\omega}$
Rect	24	0.3646π	0.4383π	0.0737π
Rect	48	0.3824π	0.4192π	0.0368π
Rect	96	0.3909π	0.4100π	0.0191π
Hamming	24	0.2596π	0.5361π	0.2765π
Hamming	48	0.3308π	0.4687π	0.1379π
Hamming	96	0.3660π	0.4340π	0.0680π

Comparing the values of $\Delta\hat{\omega}$, the ratio is $(0.0737\pi)/(0.0368\pi) = 2.003$. Doubling the order once more to $M = 96$ gives a transition width of 0.0191π, so the ratio is $(0.0737\pi)/(0.0191\pi) = 3.86 \approx 4$. For the Hamming window case, the measured transition width for $M = 48$ is $\Delta\hat{\omega} = 0.1379\pi$, and for $M = 96$, $\Delta\hat{\omega} = 0.0680\pi$. The ratios of 0.2765π to 0.1379π and 0.0680π are 2.005 and 4.066 which matches the approximate inverse relationship expected.

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