EE 508
Lab 2 Classical Approximating Functions
Fall 2024

Classical approximating functions are widely used in specifying the performance requirements of a filter. The most common classical approximating functions are the Butterworth, the Chebyschev, the Elliptiic, and the Thompson/Bessel functions. This experiment will focus on the classical approximating functions.

Part 1

a) Give the 6^{th}-order Butterworth and Chebyschev approximations for a unity gain lowpass function with a 3dB band edge of 1 rad/sec in rational fraction form.
b) Plot the magnitude and phase responses of these two approximations and compare their performance.
c) Give the 6^{th}-order Butterworth and Chebyschev approximations with the same specifications as in part a) but with a 3dB band edge of 5KHz

Part 2

The Chebyschev approximation is based upon the Chebyschev polynomials with a magnitude squared approximation of

$$H_{CC}(\omega,n,\varepsilon)=\frac{1}{1+\varepsilon^2 C_n^2(\omega)}$$

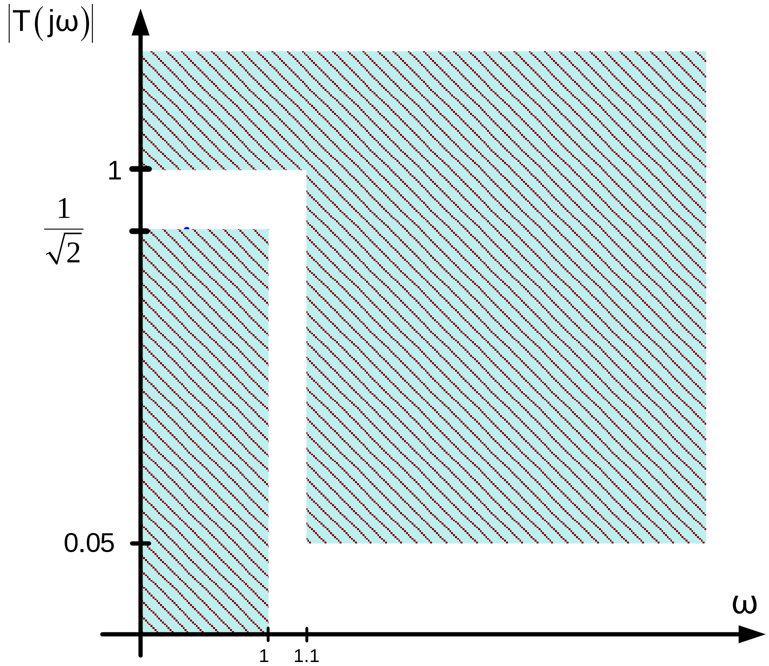
where $C_n(\omega)$ is the n-th order Chebyschev polynomial. Though $C_n(\omega)$ is an odd function for n odd, by squaring this function, an even function in ω is obtained for $H_{CC}(\omega,n,\varepsilon)$. But $C_{n-}(\omega)$ is even for n even. Consider the following magnitude-squared approximating function

$$\hat{H}_{CC}(\omega,n,\varepsilon)=\frac{1}{1+\varepsilon^2 C_{2n}(\omega)}$$

Is $\hat{H}_{CC}(\omega,n,\varepsilon)$ a useful magnitude-squared approximating function and, if so, compare the performance of $\hat{H}_{CC}(\omega,3,1)$ and $H_{CC}(\omega,3,1)$.

Part 3

Obtain the minimum-order Butterworth approximation that meets the performance requirements shown. Plot the magnitude response to show that it meets the specified performance requirements.



$|T(j\omega)|$
1
$\frac{1}{\sqrt{2}}$
0.05
ω
1
1.1