DFiltNyquist

This program designs linear phase FIR Nyquist filters. Nyquist filters are filters with an impulse response which as regular zero crossings. For an N coefficient filter, the center coefficient is one, and coefficients displaced from the center by a multiple of M are zero.

$$h[n] = \begin{cases} 1, & \text{for } n = \dfrac{N-1}{2}, \\ 0, & \text{for } n = \dfrac{N-1}{2} \pm kM. \end{cases}$$

Nyquist filters are essentially the same as interpolating filters or Mth band filters. In `DFiltNyquist` the filter is designed based on stopband performance.

Design Strategy

The design strategy decomposes the filter $H(z)$ as a product of two filters

$$H(z) = H_0(z)H_1(z).$$

The filter $H_1(z)$ controls the stopband. The filter $H_0(z)$ inserts the appropriate zero crossings into the response. The design is iterated as described in [1].

This program uses the program `DFiltFIR` to design $H_1(z)$.

Design Example

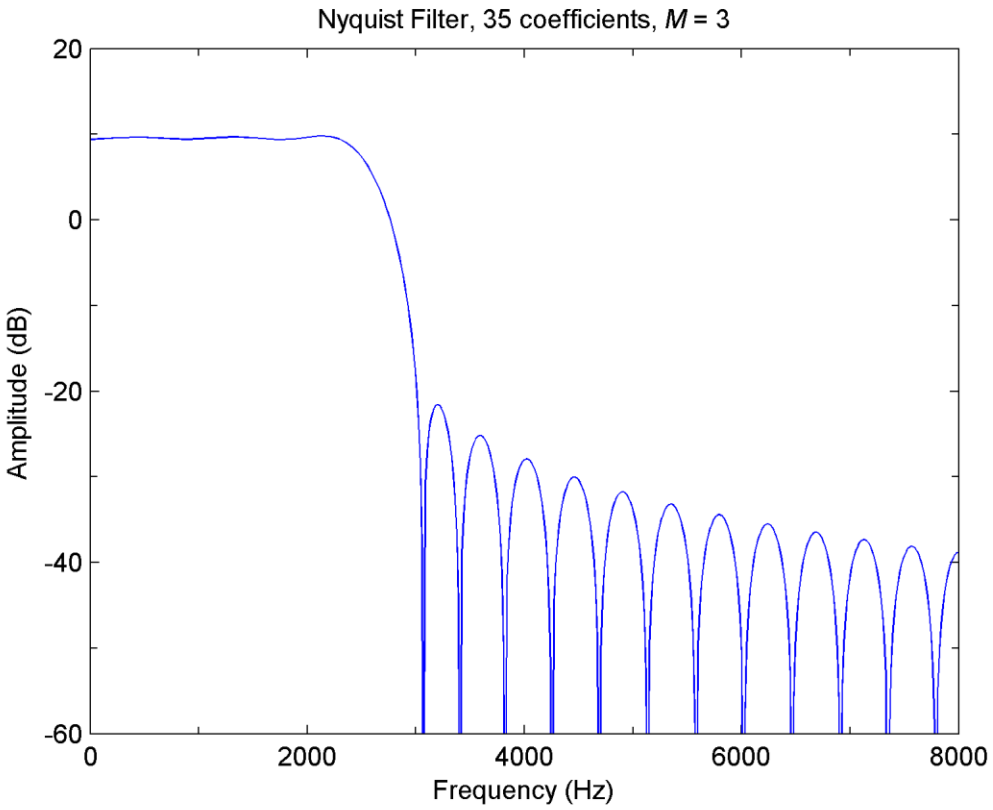
Consider a Nyquist filter with 35 coefficients, and zero-crossing interval $M = 3$. The sampling frequency is 16 kHz. The stopband starts at 3000 Hz. The stopband weight varies from 1 to 10.

```
B.Freq   = [3000 8000];
B.Weight = [1, 10];
h = DFiltNyquist(3, 35, B, 16000);
```

The frequency response of the Nyquist filter is plotted in the figure below. The passband approximates the value $M = 3$. (9.54 dB). The stopband starts at 3000 Hz. The weight in the stopband increases by a factor of 10 across the stopband . This means that the top end of the stopband is attenuated 20 dB more than the bottom end of the stopband.

References

1. R. P. Ramachandran and P. Kabal, “Minimax Design of Factorable Nyquist Filters for Data Transmission”, *Signal Processing*, vol. 18, no. 3, pp. 327–339, Nov. 1989 (available on-line at `http://www.ece.mcgill.ca/~pkabal/papers/`).


Nyquist Filter, 35 coefficients, M = 3
20
0
-20
-40
-60
Amplitude (dB)
0
2000
4000
6000
8000
Frequency (Hz)