Finite impulse response filters

In signal processing, a **finite impulse response (FIR)** filter is a filter whose impulse response (or response to any finite length input) is of a *finite* duration. If the filter order is N, than the impulse response is of the order N+1. Parks-McClelllan (also known as the Equiripple, Optimal or Minimax method). The Remez exchange algorithm is commonly used to find the optimal equiripple set of coefficients. Here the user specifies a desired frequency response, a weighting function for errors from this response and a filter order of *N*. The algorithm then finds the set of (N + 1) coefficients that minimize the maximum deviation from the ideal. Intuitively, this finds the filter that is as close as you can get to the desired response given that you can use only (N + 1) coefficients. In MatDeck we use a function firopt to design a FIR linear phase filter in such a manner. In order to estimate the required filter order according to the system requirements we use a function called firoptord.
Let us design a FIR linear phase filter with these passband characteristics: having three bands (namely lower stopband with a stopband edge at 1768Hz), passband edge with the passband edges at 2431Hz and 4862Hz and a upper stopband with stopband edge at 5967Hz. It is required that the filter has a stopband attenuation of 60dB, meaning that 0.001 in linear scale and passband deviation is equal to 0.0556 in linear scale. The sampling frequency of the system is 44100Hz. We use firoptord to estimate the filter order.

$$Fs := 44100$$

$$n := \mathrm{firoptord}\left(3\ ,\ \begin{bmatrix} 0 \\ 1768 \\ 2431 \\ 4862 \\ 5967 \\ Fs/2 \end{bmatrix} ,\ \begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \end{bmatrix} ,\ \begin{bmatrix} 0.001 \\ 0.0556 \\ 0.001 \end{bmatrix} ,\ Fs \right)$$

$$n = 132$$

The obtained filter order is 132 and now we design the filters with the same specifications.

$$h := \mathrm{firopt}\left(132\ ,\ 3\ ,\ \begin{bmatrix} 0 \\ 1768 \\ 2431 \\ 4862 \\ 5967 \\ Fs/2 \end{bmatrix} ,\ \begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \end{bmatrix} ,\ \begin{bmatrix} 1/0.01 \\ 1/0.999 \\ 1/0.01 \end{bmatrix} ,\ 0\ ,\ Fs \right)$$

We calculate the frequency response of the obtained filter

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Hf:=firfreqres(h , 128 , 1)

 freq:=curve2d(z , 0 , 1-1/128  , 128)

  fre:=col2vec(freq , 0)

 Hg:=join mat cols(fre Fs/2  , 20 log10(fabs(Hf)))
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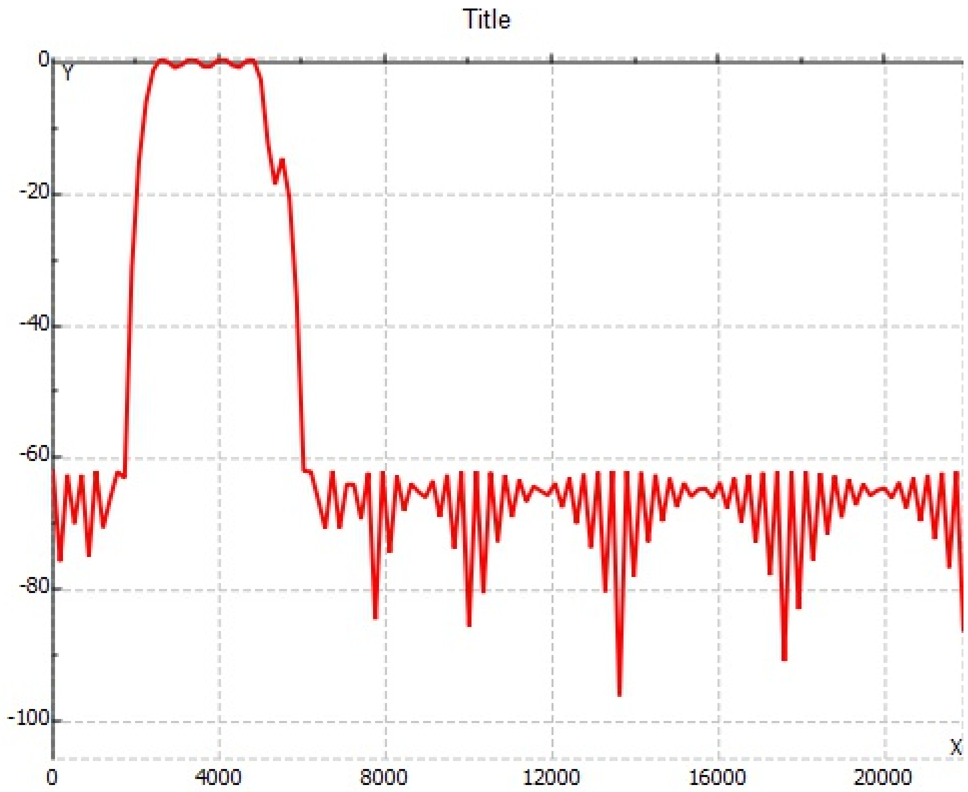
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