Filtering toolkit for FIR optimal design

Description

FIR filters are used in many DSP applications. The main advantage of FIR filters, compared to IIR filters, is in the fact that they can be designed to have a linear phase. The linear phase response is desired in DSP applications because the filter does not introduce any signal distortion as all frequency components have the same delay. The FIR filter design aims to find the minimum number of coefficients to satisfy frequency domain requirements. The optimal FIR filter is designed by using Parks McClellan method. MatDeck provides a filtering toolkit to design the optimal FIR filter as will be illustrated in this example.

Preparation of test signal

A test signal is not part of the FIR filtering form. However, we need it in order to test the filtering operation, as a created form that can filter signal at the same time. We generate a simple test signal as the sum of two sinusoidal signals of different frequencies. The sampling frequency is also defined for the overall example which is used later for the filter design within FIR filtering form.

```
Fs := 24000                              Sampling frequency
Ts1 := 1 / Fs                            Sampling period
dt := ynodes(x , 0 , 99 Ts1 , 100)       Time axis, 100 samples
f1 := 1000                               Frequency of the first sinusoidal
f2 := 6000                               Frequency of the second sinusoidal
x := 5 sin(2 π · f1 dt) + 5 sin(2 π · f2 dt)      Input signal
```

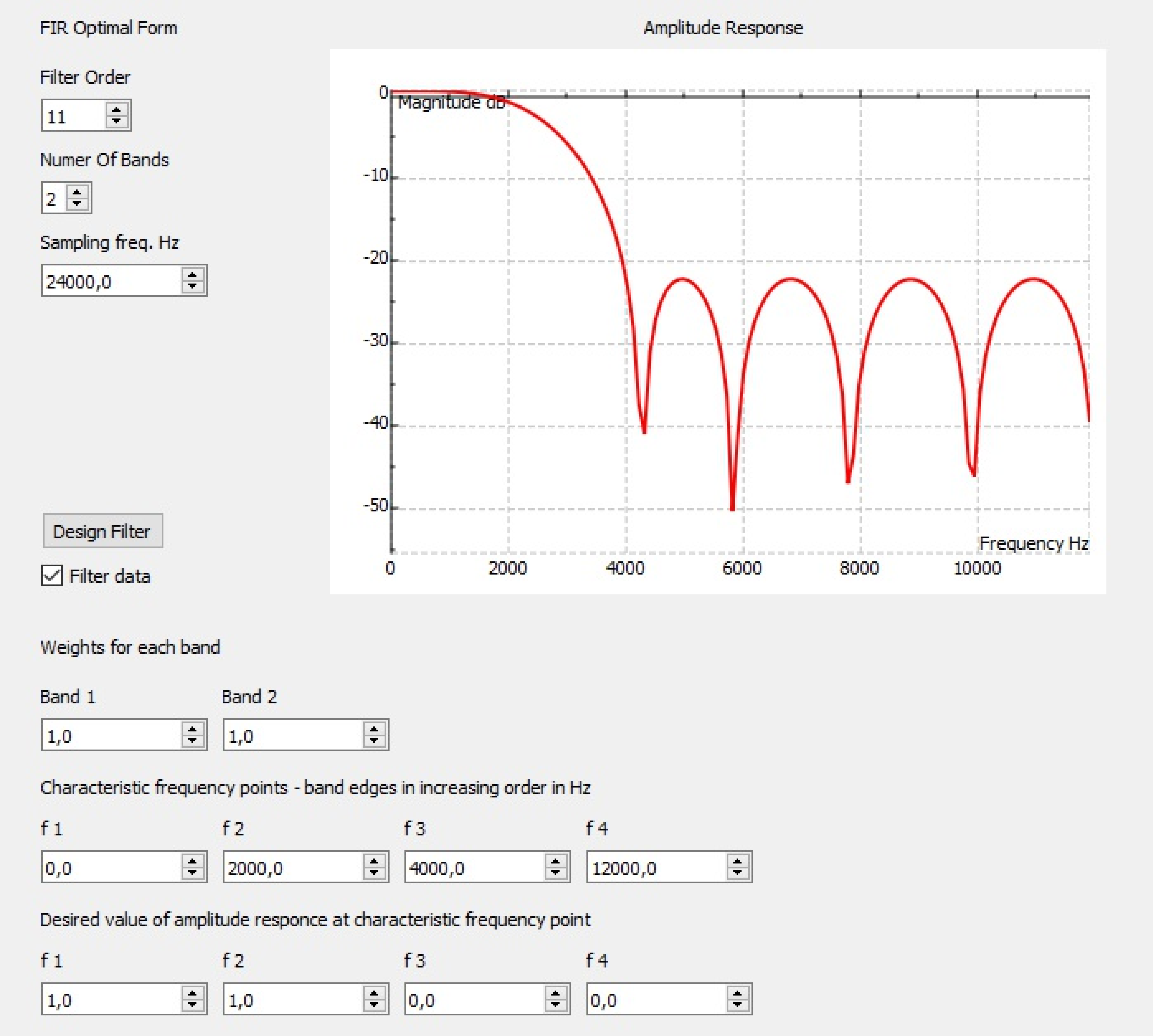
Setting filtering requirements

The next task is to define the system requirements in the frequency domain in order to illustrate how to use the filtering toolkit. Here, we have two sinusoidal signals. We can decide to keep one of them and attenuate another one. For example, if the lower frequency sinusoid is to be kept, one should design a low pass filter. In order to design a low pass filter, the filter shell has two bands, passband and stopband. The passband edges are at 0Hz and 2000Hz, and the stopband edges are at 4000Hz and 12000Hz. It is possible to put more effort to achieve performance in a certain band. However, in this example we put equal amounts of effort in both bands. The final parameter for filter design is the desired response at frequency edges, the desired response in passband is equal to one, and zero in stop band.

We initiate the FIR optimal form to perform the filter design according to the above requirements, and to filter the test signal.

```
f := firoptimalform(0 , "FormOpt14")     Initiate the filtering form
y := firoptimalresult(f , x)             Filtering signal using above form
```

The filtering form is displayed in the next page with the design requirements as above. The magnitude response of the filter is also displayed within this form.



The original test signal, and filtered signal are shown in the following graph.

graf1 := join mat cols(dt , x)

graf2 := join mat cols(dt , y)