

FIR filter design with Julia

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1 Introduction

This an example of a julia script that can be published using [Weave](#). The script can be executed normally using Julia or published to HTML or pdf with Weave. Text is written in markdown in lines starting with "#' " and code is executed and results are included in the published document.

Notice that you don't need to define chunk options, but you can using `#+`. just before code e.g. `#+ term=True, caption='Fancy plots.'`. If you're viewing the published version have a look at the [source](#) to see the markup.

2 FIR Filter Design

We'll implement lowpass, highpass and ' bandpass FIR filters. If you want to read more about DSP I highly recommend [The Scientist and Engineer's Guide to Digital Signal Processing](#) which is freely available online.

2.1 Calculating frequency response

DSP.jl package doesn't (yet) have a method to calculate the the frequency response of a FIR filter so we define it:

```
using Plots, DSP
gr()

function FIRfreqz(b::Array, w = range(0, stop= $\pi$ , length=1024))
    n = length(w)
    h = Array{ComplexF32}(undef, n)
    sw = 0
    for i = 1:n
        for j = 1:length(b)
            sw += b[j]*exp(-im*w[i])^-j
        end
        h[i] = sw
        sw = 0
    end
    return h
end
```

FIRfreqz (generic function with 2 methods)

2.2 Design Lowpass FIR filter

Designing a lowpass FIR filter is very simple to do with DSP.jl, all you need to do is to define the window length, cut off frequency and the window. We will define a lowpass filter with cut off frequency at 5Hz for a signal sampled at 20 Hz. We will use the Hamming window, which is defined as: $w(n) = \alpha - \beta \cos \frac{2\pi n}{N-1}$, where $\alpha = 0.54$ and $\beta = 0.46$

```
fs = 20
f = digitalfilter(Lowpass(5, fs = fs), FIRWindow(hamming(61)))
w = range(0, stop=pi, length=1024)
h = FIRfreqz(f, w)
```

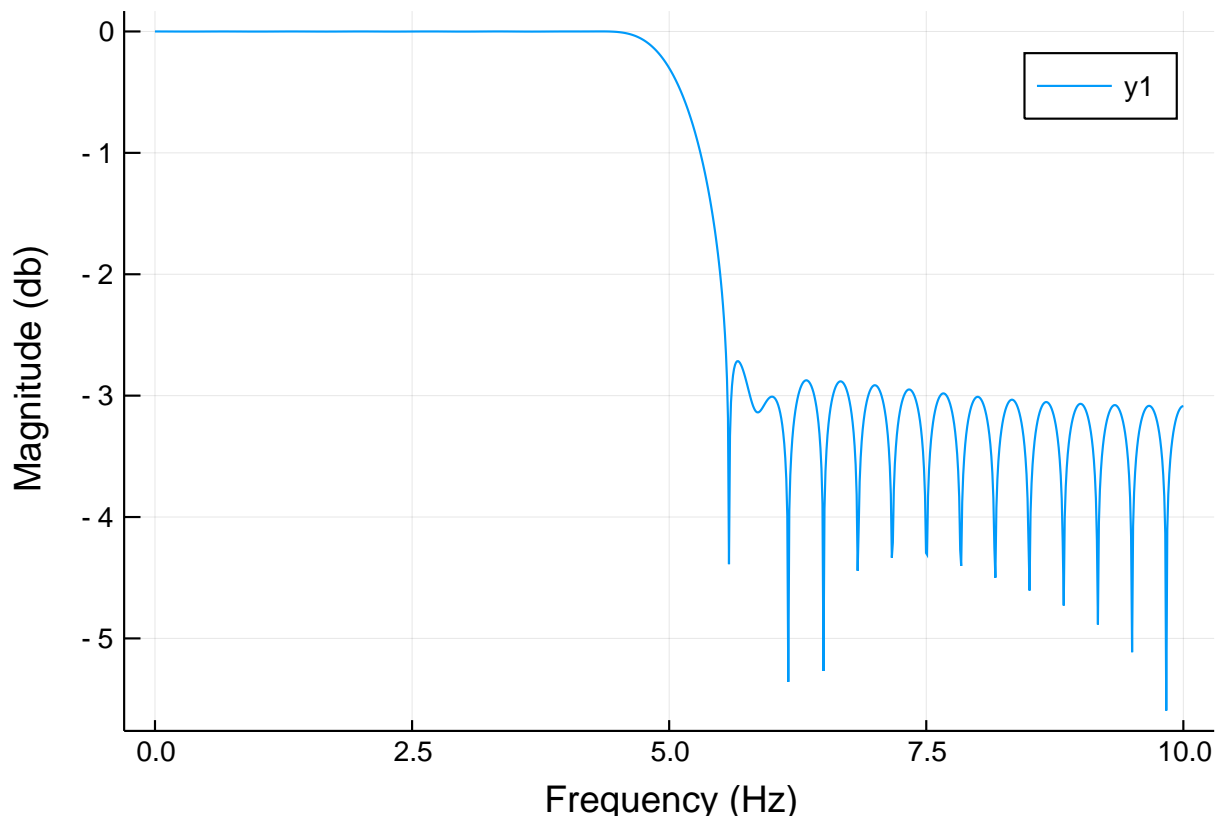
2.3 Plot the frequency and impulse response

The next code chunk is executed in term mode, see the [script](#) for syntax.

```
julia> h_db = log10.(abs.(h));

julia> ws = w/pi*(fs/2)
0.0:0.009775171065493646:10.0

plot(ws, h_db,
      xlabel = "Frequency (Hz)", ylabel = "Magnitude (db)")
```



And again with default options

```
h_phase = unwrap(-atan.(imag.(h),real.(h)))  
plot(ws, h_phase,  
      xlabel = "Frequency (Hz)", ylabel = "Phase (radians)")
```

