FIR filter design with Julia

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21th April 2016

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 Gadfly, DSP

function FIRfreqz(b::Array, w = linspace(0, ÏĂ, 1024))
    n = length(w)
    h = Array{Complex64}(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
```

2.2 Design Lowpass FIR filter

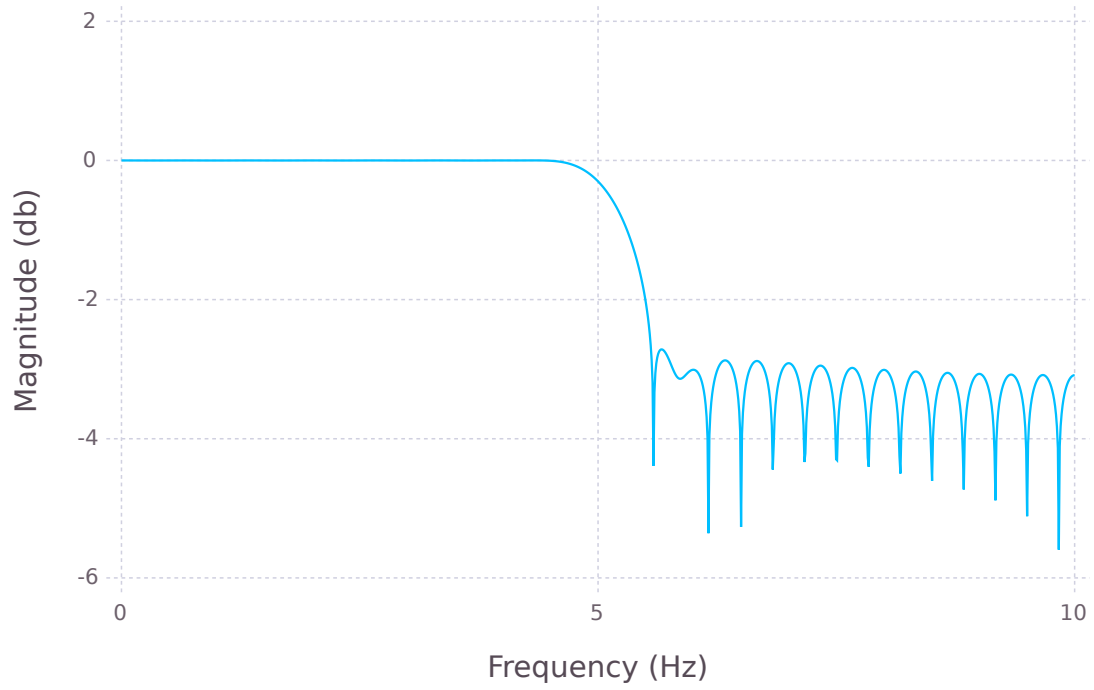
Designing a lowpass FIR filter is very simple to do with DSP.jl, all you need to do is to define the window length, cut off frequency and the window. We will define a lowpass filter with cut off frequency at 5Hz for a signal sampled at 20 Hz. We will use the Hamming window, which is defined as: $w(n)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

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

2.3 Plot the frequency and impulse response

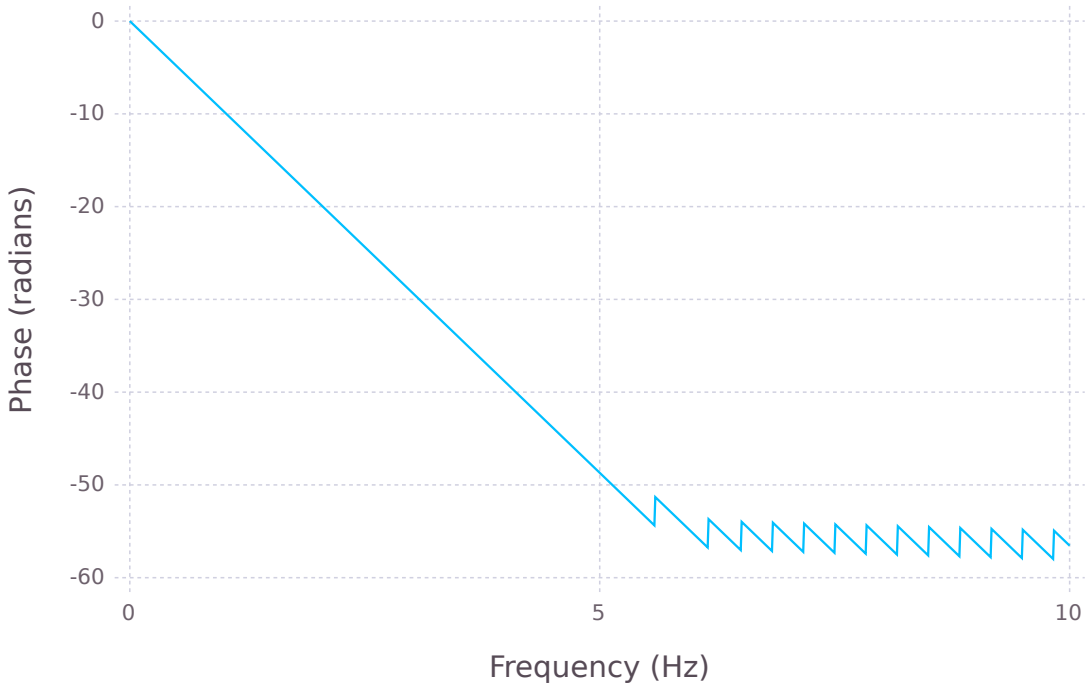
The next code chunk is executed in term mode, see the script for syntax.

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

julia> ws = w/pi*(fs/2)
1024-element LinSpace{Float64}:
 0.0,0.00977517,0.0195503,0.0293255,âĂę,9.9609,9.97067,9.98045,9.99022,10.0

plot(y = h_db, x = ws, Geom.line,
      Guide.xlabel("Frequency (Hz)"), Guide.ylabel("Magnitude (db)"))
```



And again with default options

```
h_phase = unwrap(-atan2(imag(h),real(h)))
plot(y = h_phase, x = ws, Geom.line,
    Guide.xlabel("Frequency (Hz)"), Guide.ylabel("Phase (radians)"))
```


0
-10
-20
-30
-40
-50
-60
Phase (radians)
0
5
10
Frequency (Hz)