DSP Lab 12: Filtering of an ECG signal

Objective

Students should be able to design a basic filters and perform signal filtering operations in Matlab

Theoretical notions

Matlab functions

Filter design

Use `fdatool()` for a filter design GUI. Use `fir1()`, `fir2()` or `firpm()` to design a FIR filter programmatically.

You can also use online tools like TFilter (http://t-filter.engineerjs.com/ (http://t-filter.engineerjs.com/)).

Filtering

Use `filter()` to apply a filter to an input signal:

In [ ]:
```
y = filter(b,a,x)
```

- b = the numerator coefficients of H(z)
- a = the denominator coefficients of H(z)
- x = the input signal
- y = the output filter

For an FIR filter, `a = 1` and `b =` the impulse response `h`.

Exercises

1. Load the signal from `ECGsignal.mat` and display it.
2. Filter the ECG signal with a band-pass filter between 5Hz and 100Hz (according to the recommendations here: https://www.hindawi.com/journals/isrn/2012/706217/ (https://www.hindawi.com/journals/isrn/2012/706217/). The sampling frequency of the ECG signal is 360 Hz.

    - compute the discrete cutoff frequencies of the band-pass filter
    - use the online tool TFilter to design a linear-phase bandpass filter with the required specifications
    - copy-paste the impulse response in a Matlab or Octave script
    - filter the ECG signal and display the output and the input signals
    - what is the delay introduced by filtering? (look at the peaks)

1. Use `filtfilt()` instead of `filter()` to perform zero-phase filtering of the same signal (in fact, it runs the filter twice, once from left to right and a second time from right to left). Plot the result against the original signal. Is there a delay?

Final questions

TBD