Two Interesting FIR Examples

1. Let's pretend we are speaking in church or some large hall.

David Dorran Interesting Audio Example using MATLAB to simulate talking in church!
An audio example showing where convolution is used in practice. A 'dry' speech recording is altered to sound as if were recorded in a church. Rather than modelling a complex real world system (the church) using a difference equation the impulse response is more readily available.
7:30 – **Start at about 3:30 for "Speaking in a Church" DEMO**

https://www.youtube.com/watch?v=8jCva6KHlYI

Using the `conv` function, Convolution is a mathematical process in which the output of a system can be determined if you have the systems impulse response `y = conv(x,h);` This technique is particularly useful for the situation where it is a relatively easy to determine a systems impulse response, but rather more difficult to try an model the system in question i.e. determine a set of `b` and `a` coeffients that model the behaviour of the system. Perhaps one good example of this for audio processing, whereby a recording is changed by adding 'reverberation' effect which makes the recording sound as if it was recorded in a different environment.

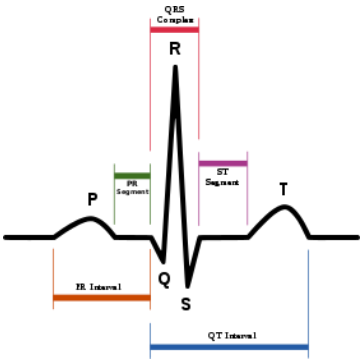
Matlab Signal Processing

Often the case that each instrument is recorded in isolation in a sound proof anechoic (echo free) environment. Then the individual recordings are added together (mixed) before finally adding an effect which makes the music sound as if it were recorded in a large venue which has musically pleasing reverberation. **This is done by convolving the music with the impulse response of appropriate venues; for example Carnegie Hall or the Sydney Opera House.** This makes the music sound as if it was actually recorded in these venues. The impulse response of these venues is effectively just a recording of the venue after a pseudo audio impulse is played i.e. a loud short bang and they are easily obtained.

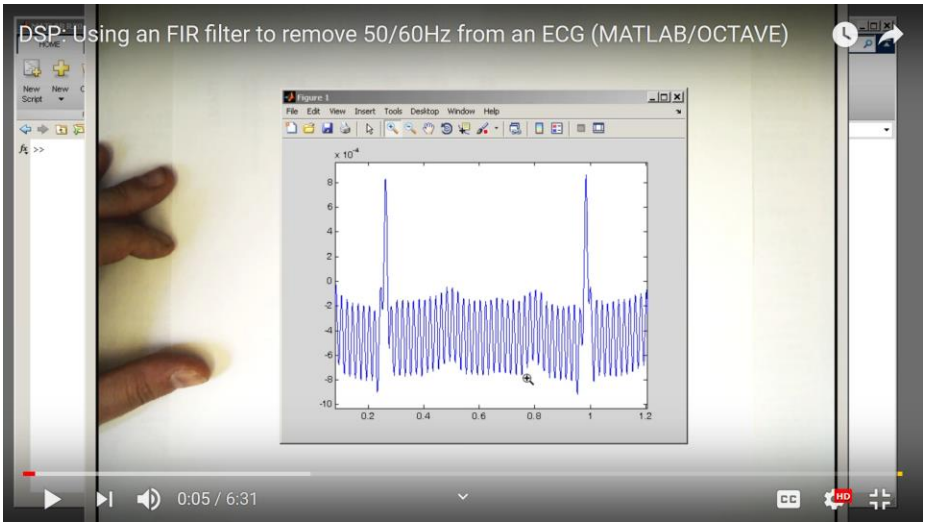
2. DSP: Using an FIR filter to remove 50/60Hz from an ECG (MATLAB/OCTAVE) 6:31

https://www.youtube.com/watch?v=r7ypfE5TQK0&feature=youtu.be

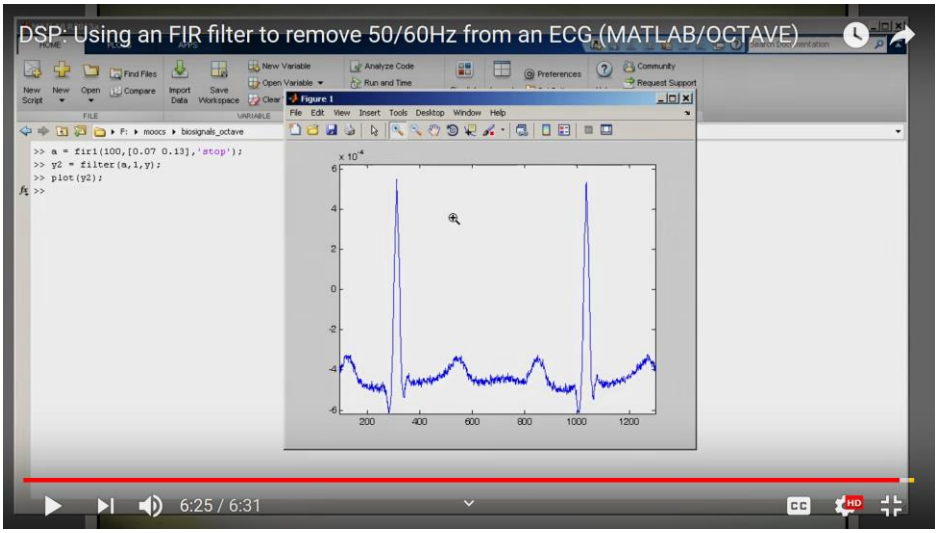
An electrocardiogram (**ECG**) is a medical test that detects heart problems by measuring the electrical activity generated by the heart as it contracts. **ECGs** from healthy hearts have a characteristic shape. If the **ECG** shows a different shape it could suggest a heart problem.



ECG with 50 Hz power-line Noise



50 Hz Notch Filter removes most of the 50 Hz noise from the ac lines.



fir1 FIR filter design using the window method.

B = fir1(N,Wn) designs an N'th order lowpass FIR digital filter and returns the filter coefficients in length N+1 vector B.

The cut-off frequency Wn must be between 0 < Wn < 1.0, with 1.0, corresponding to **half the sample rate**. (Normalized frequency based on the Nyquist frequency normalized).

The filter B is real and has linear phase. The normalized gain of the filter at Wn is -6 dB.

(Remember -3 dB is half power P= 10 log(1/2) = -10 log(2) = - 10* 0.30102999566 or -3 dB.)