6.s02: EECS II - From A Medical Perspective

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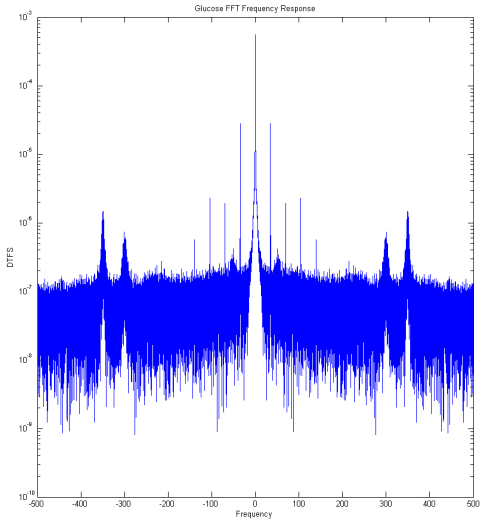
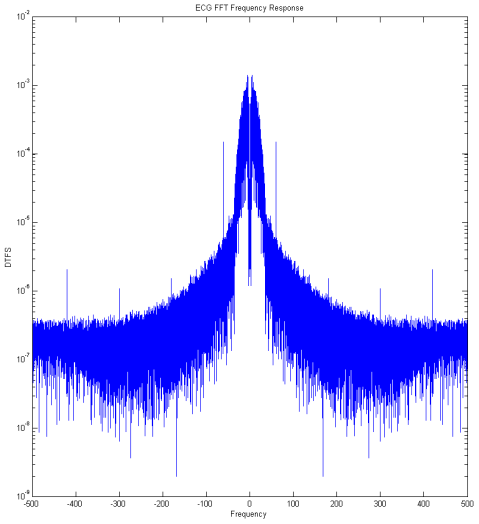
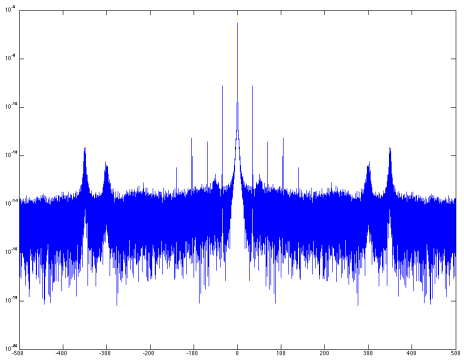
1. (a) Frequency spectrum of glucose and ECG signals.

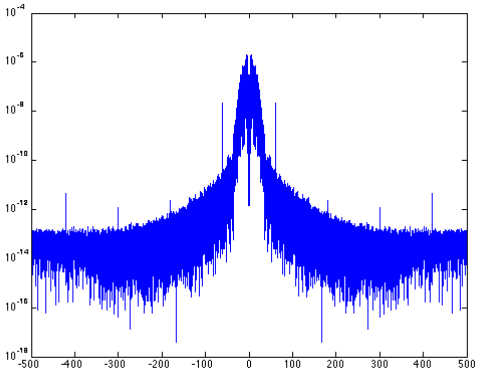





```
N = length(xg0);

xg0fftUnshifted = fft(xg0)/N;
xe0fftUnshifted = fft(xe0)/N;

xg0fft = fftshift(xg0fftUnshifted);
xe0fft = fftshift(xe0fftUnshifted);

f = linspace(-500, 500*(1-1/N), N);

semilogy(f, abs(xg0fft));
xlabel('Frequency');
ylabel('DTFS');
title('Glucose FFT Frequency Response');

semilogy(f, abs(xe0fft));
xlabel('Frequency');
ylabel('DTFS');
title('ECG FFT Frequency Response');
```

(b) Energy spectral density of glucose and ECG signals.






```
% Using variables defined in (1a)
xg0s = abs(xg0fftUnshifted).^2;
xg0sfft = fftshift(xg0s);
semilogy(f, xg0sfft);

xe0s = abs(xe0fftUnshifted).^2;
xe0sfft = fftshift(xe0s);
semilogy(f, xe0sfft);
```

(c)

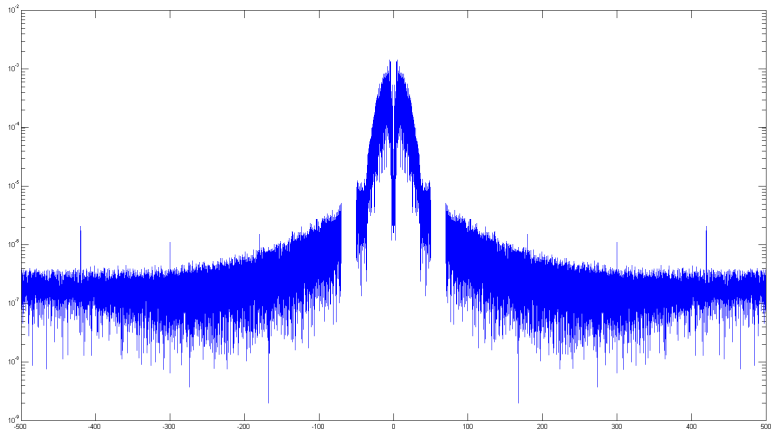
Glucose	1	5	100	500
E_T	0.0850	0.0850	0.0850	0.0850
$E(f_1, f_2)$	2.0e-04	8.1e-05	1.77e-05	1.0e-11
Ratio	0.0024	9.6e-04	2.09e-04	1.2e-10

ECG	1	5	100	500
E_T	21.622	21.622	21.622	21.622
$E(f_1, f_2)$	10.810	8.4107	1.7e-04	2.6e-09
Ratio	0.5000	0.3890	7.9e-06	1.2e-10

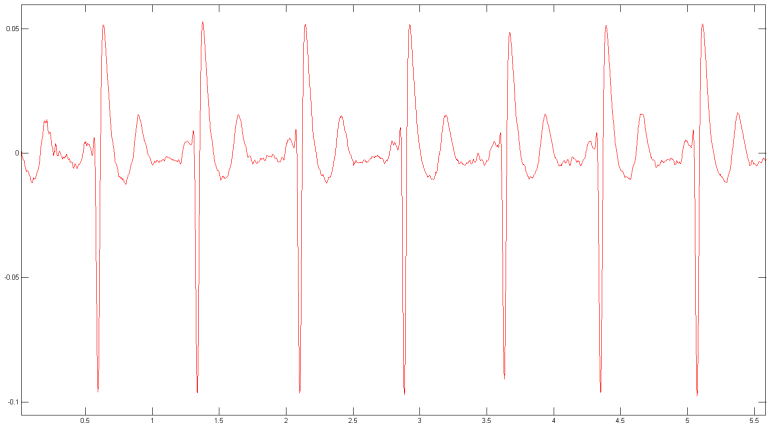
```
% Using variables defined in (1a) and (1b)
f1 = 500;
f2 = 500;

k1 = N*f1 / 1000;
k2 = N*f2 / 1000;

EtG = N * sum(xg0s);
EfG = N * sum(xg0sfft(floor(k1+(N-1)/2):floor(k2+(N-1)/2)));
GlucoseRatio = EfG / EtG;

EtE = N * sum(xe0s);
EfE = N * sum(xe0sfft(floor(k1+(N-1)/2):floor(k2+(N-1)/2)));
ECGRatio = EfE / EtE;
```

(d) placeholder

2. Fourier coefficients of notch filter



Filtered ECG signal



```
function H0 = notchFilter(N, lowFrequency, highFrequency)
    middle = N/2;
    lowK = 60 * lowFrequency;
    highK = 60 * highFrequency;
    H0 = ones(N,1);
    H0(middle-highK:middle-lowK) = 0;
    H0(middle+lowK:middle+highK) = 0;
end

N = length(xe0);
xe0fftUnshifted = fft(xe0)/N;
xe0fft = fftshift(xe0fftUnshifted);
H0 = notchFilter(N, 50, 70);
xe0Filtered = ifft(ifftshift(H0 .* xe0fft))*N;
```