
Problem 2

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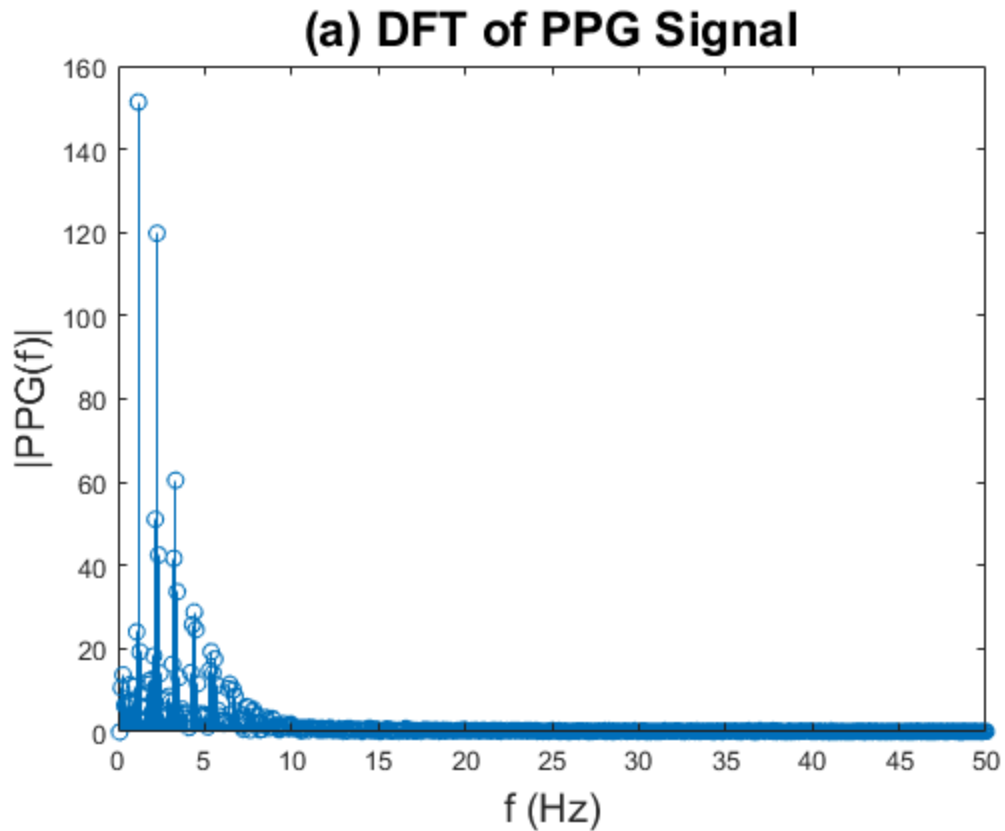
Discrete Fourier Transform

```
ppg = readmatrix('ppg_100hz_1024samples.csv');  
fs = 100;  
PPG = fft(ppg);  
N=length(PPG);
```

Plot FFT and finding frequency with maximum magnitude

```
figure  
stem(fs/N*(1:length(PPG)/2), abs(PPG(1:end/2)))  
xlabel('f (Hz)', 'FontSize', 15)  
ylabel ('|PPG(f)|', 'FontSize', 15)  
xlim([0 fs/2])  
title('(a) DFT of PPG Signal', 'FontSize', 18)  
  
% Find frequency with maximum magnitude  
[M, I_PPG] = max(abs(PPG(1:end/2)));  
PPG_maxmag = fs*(I_PPG - 1)/length(PPG);  
fprintf("Frequency of highest magnitude in the FFT is "+PPG_maxmag+"  
Hz.\n")  
fprintf("Heart rate computed using FFT is "+PPG_maxmag*60+" beats per  
min.\n")
```

*Frequency of highest magnitude in the FFT is 1.0742 Hz.
Heart rate computed using FFT is 64.4531 beats per min.*



Plot Autocorrelation

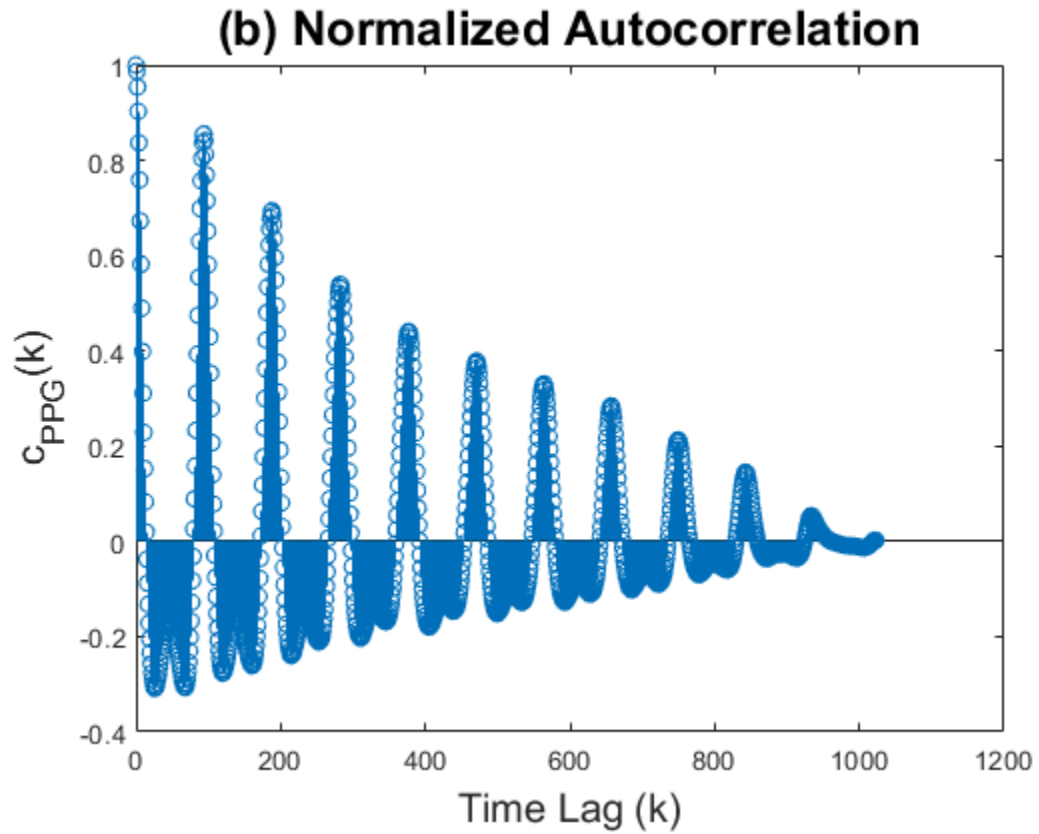
```
[c_ppg, lags_ppg] = xcorr(ppg, 'coeff');
figure
stem(lags_ppg(ceil(end/2):end), c_ppg(ceil(end/2):end));
xlabel('Time Lag (k)', 'FontSize', 15)
ylabel('c_{PPG}(k)', 'FontSize', 15)
title('(b) Normalized Autocorrelation', 'FontSize', 18)

% Downward zero crossing for PPG
firstcrossing = 0;
for i = floor(length(c_ppg)/2):length(c_ppg)
    if c_ppg(i) > 0 && c_ppg(i+1) < 0
        if firstcrossing == 0
            firstcrossing = 1;
            firstindex = i;
        else
            freq_ppg = 1/((i - firstindex)/fs);
            break
        end
    end
end
end
fprintf("Frequency computed using autocorrelation is "+PPG_maxmag+"
Hz.\n")
```

```
fprintf("Heart rate computed using autocorrelation is "+freq_ppg*60+"
beats per min.\n")
```

Frequency computed using autocorrelation is 1.0742 Hz.

Heart rate computed using autocorrelation is 63.8298 beats per min.



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