Adam Belhouchat

Joey Miller

Report

```
load('Periods.mat');
load('RealSignals.mat');
for a=1:10
sig=Y_RealSignals{a};
true_period=Periods(a);

sample_rate=1;
L=length(sig);

Y=SFFT(sig,50);
Y_norm=abs(Y/L);
Y_final=Y_norm(1:L/2+1);
mean_y=mean(Y_final);
std_y=std(Y_final);
[peaks,locations]=findpeaks(Y_final,'MinPeakHeight',mean_y+9*std_y);
f=sample_rate*(0:(L/2))/L;
plot(f,Y_final);

guess_period=floor(1/f(locations(1)));

disp(guess_period==true_period)

end
```

Our algorithm finds the period of a signal by performing a sparse FFT on the signal and finding the first peak in this signal above a certain threshold as the frequency of the signal. We then take the floor of the inverse to get the period. We first find the sFFT and normalize it to keep the values consistent between different signals. We only consider the first half, as the second half is simply the first half flipped around. Then we find the mean and standard deviation of the sFFT and find all peaks (and their indices) of the sFFT greater than the mean + 9 standard deviations. We create a frequency axis to find the true frequencies for the sFFT and find the frequency corresponding to the first peak. Finally, we take the floor of the inverse of this peak to obtain the period.

The algorithm runs in linear time. Due to the fact that the algorithm utilizes the sparse fourier transform the most expensive function calls are linear time operations such as abs, mean, std, and findpeaks. These functions operate on O(n) time whereas the SFFT function provided for this assignment runs utilizing O(klog(N/k)log(N)) where k stands for the sparsity parameter. In our code we let k = 50 causing all signals passed in this function to have their periods calculated in worst case time of O(50log(N/50)log(N).

The final version of our algorithm was produced mainly through trial and error. We settled on a peak threshold of 9 standard deviations because it gave the best accuracy. Similarly, we chose k=50 because it gave a good balance between detail and speed. The reason we create a separate frequency axis rather than just plotting on the generic [1, 2, 3…] axis is so that we can get the true frequency values of the Fourier transform. This way, we only need to find the inverse of a value to get the period. We choose the first peak of the sFFT to be the period because when we looked at the graphs for ECG data, we noticed there were short peaks interspersed with tall peaks at regular intervals. These could be mistaken for a frequency component of the signal, which would give a larger frequency than desired. As time goes on these smaller peaks will cause the frequencies to be more inaccurate on the frequency domain. Choosing the first peak, and therefore the lowest frequency, decreases the chance that we choose a period that has been influenced by the smaller peaks in the ECG data.