HKUSTx: ELEC1200.2x A System View of Communications: From Signals to...

LAB 2 - TASK 3 (1 point possible)

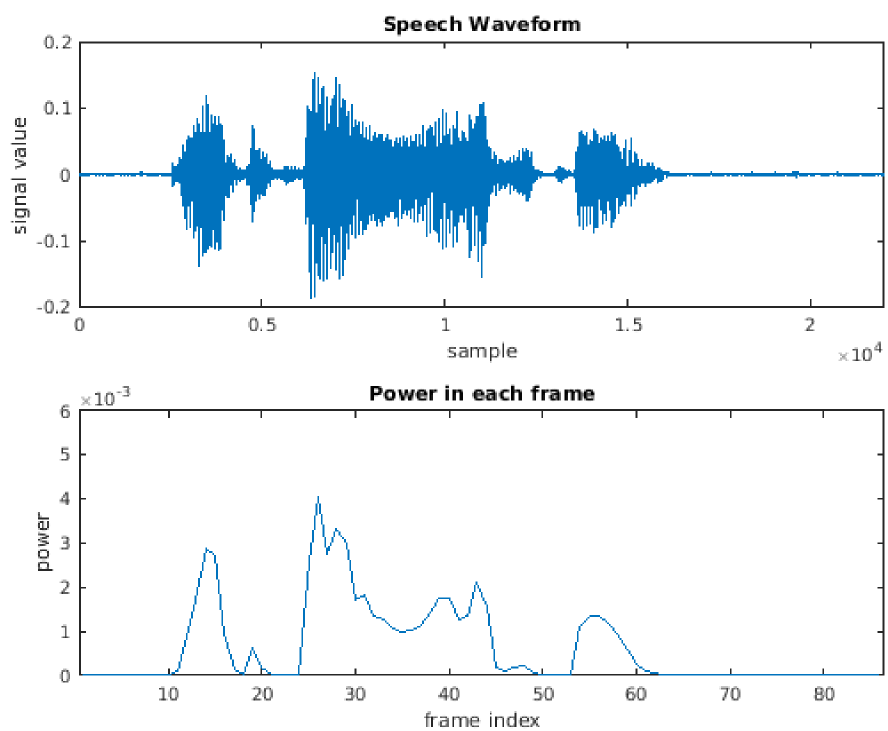
In this lab, you will visualize the amplitude spectrum for different frames of the speech signal. You will also extract the most significant (highest amplitude) frequency components.

```
    % plot the amplitude spectrum of the frame
    subplot(2,2,2+i)
    plot(k,A); hold on;
    plot(ksig,Asig,'rx','LineWidth',2,'MarkerSize',8); hold off;
    title('amplitude spectrum');
    ax = axis;
    axis([0 frame_length/2 ax(3:4)]);
    hold on;
    grid;
    xlabel('k'); ylabel('amplitude')
end
% % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % %
% show the figures in the right order on Edx
figure(1);

```

Unanswered

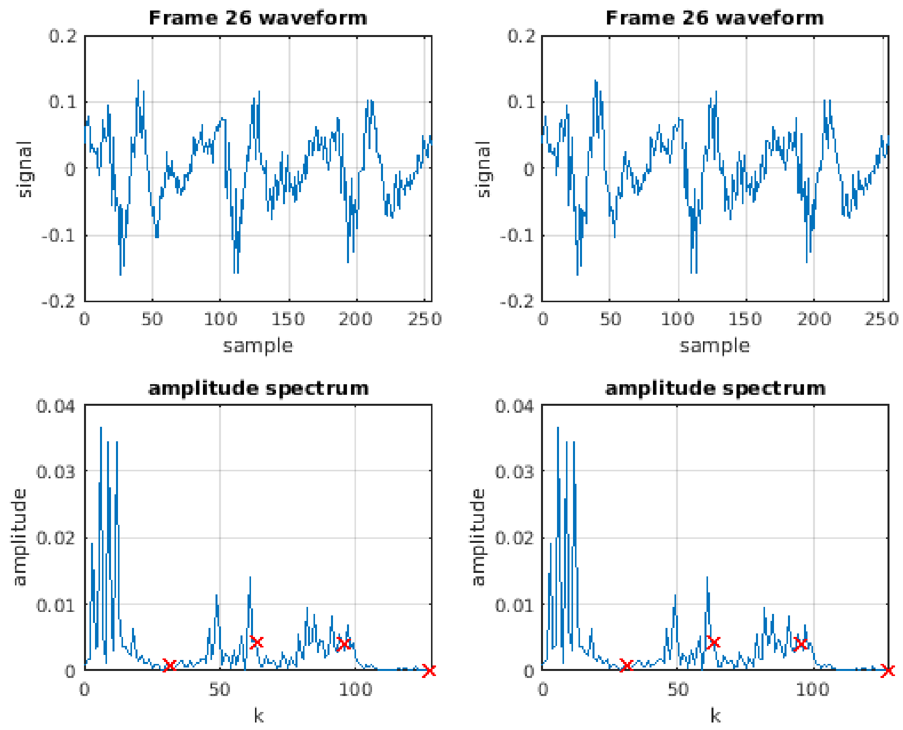
Figure 1



tutorials

- MATLAB Sandbox

Figure 2



Run Code

You have used 0 of 10 submissions

INSTRUCTIONS

The initial MATLAB code in the above window computes the amplitude spectrum for two frames in the signal. In this task, your task will be to find the most significant frequency components, i.e. those with the highest amplitude.

If you click the **Run Code** button, the initial code will generate two figures. As in task 1, the first figure plots the waveform of the signal (subplot 1) and the power of the frames (subplot 2). The second figure shows the waveform of two frames, one on the left and the other on the right, and the corresponding amplitude spectrum. The red '**x**'s in the spectrum should indicate the four frequency components with the largest amplitudes. Due to some mistakes in the code, in figure 2, the frames on the left and on the right are the same and the four main components are not located correctly. Your job is to correct the code.

The first part of the initial code is the same as that in Task 1, where a speech signal is loaded and copied into the variable **x** and the frame length is set to 256 samples (variable **frame_length**). It then computes the power of each individual frame, and plots the original waveform and the power as functions of time. The code then finds the index of the frame with the highest power (**fnum**).

The vector **nf** contains the indices of two frames whose spectra we wish to compare. Initially, the two elements are identical, which is why the two amplitude spectra are identical. Your first task is to change **nf(2)** in order to compare the spectrum of the frame with highest power with the spectrum of another frame. Look at different frames and observe how the spectra change. These changes in spectra are due to changes in the sounds being spoken at different points in the recorded utterance. Once you are done exploring, leave the value of **nf(2)** at a value different than **nf(1)**.

Inside the loop, the code computes and plots the amplitude spectrum of the two frames selected by **nf**. It first extracts one frame using the function **extract_frame**. It then computes its Fourier series expansion using the function **fseries**. The outputs of **fseries** are the amplitude, **A**, and the phase of each frequency component, **phi**. Since there are **frame_length**/2+1 frequency components, both **A** and **phi** have **frame_length**/2+1 elements. The corresponding frequency indices are held in the vector **k**, which takes integer values from 0 to **frame_length**/2.

The next part of the code should compute the indexes (variable **ind**) of the four frequency components with the largest amplitudes, listed in descending order of amplitude. In other words, the first element of **ind** should contain the index of the frequency component with the largest amplitude. The fourth element of **ind** should contain the index of the frequency component with the fourth largest amplitude.

The variable **ind** is then used to gain access to frequency value (**ksig**), amplitude (**Asig**) and phase (**phisig**) of each component. However, due to a mistake in the implementation, these values are wrong. You can notice that by looking at the red markers in subplot 2. These should appear at the four largest peaks in the plots of the amplitude spectra. Your second task is to revise the code that calculates the indexes.

The remainder of the code is used to generate the plots.

To summarize, in this exercise you need to complete two tasks:

1. change the value of **nf(2)** in order to compare two different frames;
2. revise the code that generates the variable **ind**.

Change the code between the lines

% % % % Revise the following code % % % %

and

% % % % Do not change the code below % % % %

Please, revise the code without modifying the variables varibles **x**, **Fs**, **frame_length** and **nsig**.
