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Math 362 Fourier Analysis

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Ch. 4.5

Section 4.5

4.5.3

Use the MATLAB program spectrum2sines(m,n) to do the following. Be sure to show the command used for each.

1. Plot the time and frequency domain graphs of relative to along with the frequency domain graphs of relative to and 1,2).
2. From the frequency domain graph of relative to , can you determine the two dominant frequencies of If so, can you determine the time-dependence of these two dominant frequencies from this graph.
3. From the frequency domain graphs of relative to and , can you determine the two dominant frequencies of Can you determine the time-dependence of these two dominant frequencies from these graphs?
4. Find the spectrum matrix D.
5. Plot the spectrogram corresponding to
6. Interpret the results given by the spectrogram.

a.)

|  |  |
| --- | --- |
| Input Commands | Output (Plot if Applicable) |
| >> spectrum2sines(3,7) |  |

b.)

In the preceding images, we can see from the time domain graphs of the interval that there are dominant frequencies with values of 3 and 7 respectively. It cannot be deduced that these entries are time dependent.

c.)

From the two separate frequency domain graphs we can see the dominant frequencies of each a lot easier because the frequency blurring is minimized in these graphs. We can see in each of these separate plots that they are time dependent around a value of 10.

d.) & e.)

|  |  |
| --- | --- |
| Input Commands | Output (Plot if Applicable) |
| >> spectrum2sines(3,7) | D =  0.0000 0.0000  0.0000 0.0000  0.0000 0.0000  0.5000 0.0000  0.0000 0.0000  0.0000 0.0000  0.0000 0.0000  0.0000 0.5000  0.0000 0.0000  0.0000 0.0000 |

f.)

From the spectrogram plot we can deduce that the 3 Hz frequency appears before the 7 Hz signal which can be expected. In the matrix we can see that there are only values in the 3rd and 7th entry of the columns, which makes sense since those values are the two frequencies of this spectrum2sines plot.

4.5.23

Use the MATLAB program spectrum4cosines(a,b,c,d) to do the following. Be sure to show the command used for each.

1. Plot the time and frequency domain graphs of relative to along with the frequency domain graphs of relative to ,
2. From the frequency domain graph of relative to , can you determine the four dominant frequencies of If so, can you determine the time-dependence of these four dominant frequencies from this graph.
3. From the frequency domain graphs of relative to , can you determine the four dominant frequencies of Can you determine the time-dependence of these four dominant frequencies from these graphs?
4. Find the spectrum matrix D.
5. Plot the spectrogram corresponding to
6. Interpret the results given by the spectrogram.

a.)

|  |  |
| --- | --- |
| Input Commands | Output (Plot if Applicable) |
| >> spectrum4cosines(5,4,2,1) |  |

b.)

From the frequency domain plot of it is very hard to pick out what the dominant frequencies are. In this plot we see a lot of frequency blurring and that is the biggest contributing factor to why we can’t determine the dominant frequencies. The time dependency is lost in this graph.

c.)

From the frequency domain graphs of the separate intervals we can determine the dominant frequencies from each one. The corresponding dominant frequencies are 5, 4, 2, and 1. We can also see that these are time dependent in their separate graphs around a value of 8.

d.) & e.)

|  |  |
| --- | --- |
| Input Commands | Output (Plot if Applicable) |
| >> spectrum4cosines(5,4,2,1) | D =  0.0000 0.0000 0.0000 0.0000  0.0000 0.0000 0.0000 0.5000  0.0000 0.0000 0.5000 0.0000  0.0000 0.0000 0.0000 0.0000  0.0000 0.5000 0.0000 0.0000  0.5000 0.0000 0.0000 0.0000  0.0000 0.0000 0.0000 0.0000  0.0000 0.0000 0.0000 0.0000 |

f.)

From the spectrogram of these values we can see the frequencies are 5, 4, 2, and 1 in order respectively. We also see the places in the columns where there are entries in the matrix for the 5th, 4th, 2nd, and 1st entries of the columns.

4.5.26

In the following exercise, use the MATLAB program SpectrogramPlot(x,sr,ymax) to do the following for the sound wave indicated. Be sure to show the MATLAB commands used for each.

1. Plot the spectrogram for the sound wave. Experiment with the plot parameters for the SpectrogramPlot m-file as needed. Choose an appropriate plot to include here.
2. Briefly discuss what the spectrogram shows us about the sound wave and relate the visual information to what is heard.

a.)

|  |  |
| --- | --- |
| Input Commands | Output |
| >> [x,sr]=audioread('Audio.wav');  >> SpectrogramPlot(x,sr,100) |  |

b.)

From the spectrogram plot we can see that the colors corresponding to higher frequency voice waves are blue and green where the lower frequency waves are yellow. This sound wave that I recorded primarily consists of lower frequency terms, but where the colors change is where we can observe a voice inflection and where someone starts to speak up.