14:440:127– Introduction to Computers for Engineers

PROJ04

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1 Sound

For this project you will have to do some reading before you can begin. Below is a list of websites I recommend you stick to. There is an incredible amount of literature out there and you may get more confused than anything else, so stick to a few good resources.

- `http://www.relisoft.com/science/physics/sound.html` This resource has great information about the physics of sound and programming concepts.
- `http://www.intmath.com/Fourier-series/7_Fast-fourier-transform-FFT.php` This website has examples of FFT and also great illustrations regarding the physics of sound.
- `http://en.wikipedia.org/wiki/Fourier_transform` The wiki may have highly elaborate mathematical explanations that may not be clear, but you should check it out too.
- `http://en.wikipedia.org/wiki/Frequency` If you need to reminder about frequency.
- `www.mathworks.com/help/techdoc/ref/fft.html` Of course, you should read MatLab documentation online or type in **help fft** and navigating to the documentation through there.
- `http://people.revoledu.com/kardi/tutorial/Similarity/Normalization.html` This website has good information regarding normalization of data.

2 Project Description

For this project you will be given the freedom to develop a program that reflects your understanding of MatLab scripting. I will provide you with some audio files - MatLab allows you to process **.wav** files only. However, as was the case for the image processing project, your program should work for ANY file that is used as long as it is a **.wav** file.

For any file being processed, you will need to answer the following questions, and complete the mentioned processes:

1. What is the size of the signal (how many samples, how many channels)? *Hint: You may find it instructional to learn, if you don't already know, what a channel is in this context?*
2. What is the sample rate, and how many bits are used per sample?
3. How long is your sample (in seconds)?
4. Play the original audio signal in MatLab, when user desires it

5. Plot the entire signal vs time
6. Plot **any** consecutive 1000 samples of your signal vs time - allow user to determine this range interactively
7. Determine the amplitude, Nyquist Frequency & the strongest frequency in the signal (this is also know as the principal frequency)
8. Plot the normalized magnitude vs time
9. Plot frequency vs magnitude(normalized), and on this same plot, show where the principal frequency is located

You **must** give good descriptions (in the form of comments in your code) for your findings and your path of thought as you arrived at these solutions. You can create a *GUI* if you'd like, or use *menus*, or any other tool learned in this class, this semester. You should be creative in your design and MAKE SURE that your program is **user friendly**. Make your program as interactive as possible, and avoid writing long messages to the screen - nobody likes to read that.

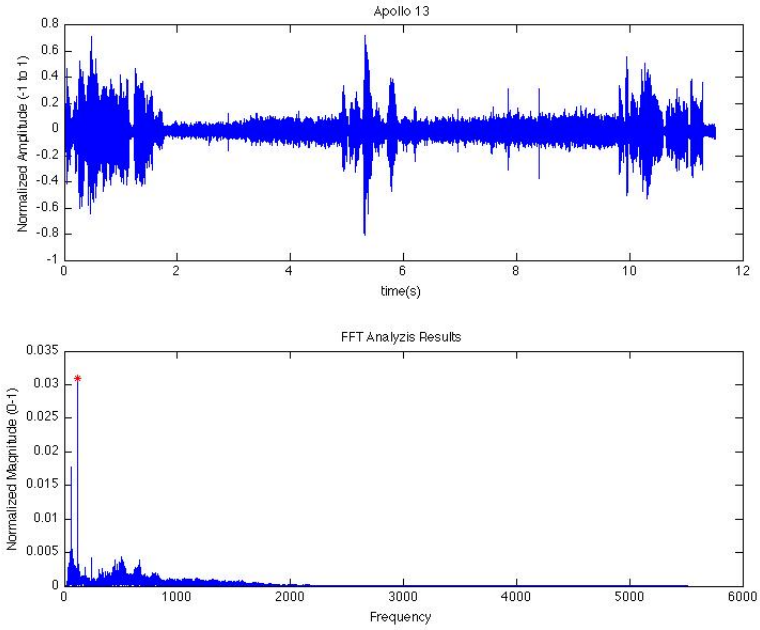
3 Project Requirements

- You are required to provide solutions for #1 - #8 (above in Project Description) for any **.wav** file read into MatLab
- You are required to use the **uiopen** function to find the desired **.wav** file
- You are required to error check when necessary to avoid your program crashing

4 Example

Below are *some* results as a sample of what this project requires you to deliver. For the following example, the *apollo13prob.wav* file is used. Once you have read in the sound file, and have determined #1-#3, you can play your file as well(#4). The real trick will come afterwards, when you have to start plotting your signal after analyzing it.

The following image shows the *apollo13prob.wav* signal vs time on one plot and on another plot the normalized magnitude vs frequency.



5 Useful Functions

Here is a list of functions you may find useful in your project:

wavread
plot, subplot, title, xlabel, ylabel
fft
sound
abs
length
max GUI related functions

6 Grading Rubric

4 points will be given for how well you deliver solutions to #1 - #8 (above in Project Description) for any signal queried. Deductions will be made accordingly.
1 point will be given for using **uiopen** and error checking where necessary in your program. Depending on your solution, error checking may carry the most weight.
2 points will be given for your programming creativity. You will be awarded 2 points if your program is easy to work with, if your messages to the user are short and to the point, if you provide the signal's information in a coherent and compact manner. I suggest that you p

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The first day of this class' exam is Tuesday, December 7th.
The last day of this class' exam is Monday, December 13th.
Reading days before FINAL EXAMS are December 14 & 15.

The deadline for this project will be: Friday, December 17th @ 10PM SHARP!
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Good Luck on your exams!