

Matlab Assignment 3

Due date: Nov 19

In this assignment, you will design a lowpass filter to remove noise from a speech signal.

1. Download the audio clip “phrase_noise.wav”. The clip contains a speech signal mixed with high frequency noise. Read and play it using the following Matlab functions.

```
[x, Fs]=wavread('phrase_noise.wav');  
  
sound(x, Fs);
```

2. Design a lowpass filter “f_LP” to remove the noise, and use “fvtool” to visualize “f_LP”.

3. Generate the output signal and play it in Matlab.

```
x_LP=filter(f_LP, x);  
  
sound(x_LP, Fs);
```

What does the audio say? Experiment with different values of the following parameters:

- passband frequency
- stopband frequency
- passband ripple
- stopband attenuation .

4. Compute the DTFT of “x” and “x_LP”, and plot their magnitude. (You should reuse the code developed in Matlab Assignment 2). By analyzing the frequency representation of the signal, can you determine the parameters “passband frequency” and “stopband frequency” in designing the lowpass filter?

Please submit your Matlab code and a report through Blackboard. The report should contain answers to the following questions:

- What does the audio say?
- Explain your choice for “passband frequency” and “stopband frequency”.

Matlab Help on fdesign

fdesign Digital Filter Design.

D = fdesign.<RESPONSE> returns a set of specifications that can be used to design filters specified by RESPONSE, such as lowpass, highpass, and many other types of filters. Type "help fdesign/responses" to get the list of supported responses.

The design process creates the filter coefficients and associates a particular filter structure to those coefficients. To design a filter use the following command:

design - Design the filter from the specifications.

Other functions that can aid the design process:

designmethods - Available design methods for the specifications given.

help - Display help for a particular design method.

designopts - Return a structure of design options to be used with design.

designoptions - Show all design options available for a particular design.

validstructures - Show valid filter structures for a particular design.

To process data through the filter, see dfilt/filter and mfilter/filter.

EXAMPLE - Design a minimum order lowpass filter with

```
% a normalized passband frequency of 0.2,
```

```
% a stopband frequency of 0.22,
```

```
% a passband ripple of 1 dB,
```

```
% and a stopband attenuation of 60 dB.
```

```
d = fdesign.lowpass('Fp,Fst,Ap,Ast',0.2, 0.22, 1, 60);
```

```
f = design(d, 'equiripple'); % Design an FIR equiripple filter
```

```
info(f)                    % View information about filter
```

```
% Other designs can be performed for the same specifications
```

```
designmethods(d,'iir'); % List the available IIR design methods
```

```
f = design(d, 'ellip') % Design an elliptic IIR filter (SOS)
```

```
fvtool(f)                % visualize various filter responses
```

```
input = randn(100,1);  
output = filter(f,input); % Process data through the elliptic filter.
```

```
% Many designs such as equiripple allow for various options to  
% be specified at design time.
```