Faculty of Engineering
Electronics and communication Engineering Department

Matlab assignment

Echo generation system

Presented by

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Code description:

- **Adding echo to the audio**

```
% %---------- read a .wav file------------------

[y,Fs] = audioread('signals.wav'); %audio read is a function to read a
ylen=length(y);    % we calculate the total number of samples in the a

T = ylen/Fs; % in this line we calculate the time of the audio file

%in the next three lines we define a matrix where each row consists of
%delay and the magnitude of this delay
U_input_1 = [0.2 0.5; 0.4 0.3; 0.6 0.1]; %strong echo signal
U_input_2 = [0.4 0.5; 0.8 0.3; 1.2 0.1]; %medium echo signal
U_input_3 = [0.6 0.5; 1.2 0.3; 1.8 0.1]; %weak   echo signal
for k=1:3 %for loop to print the figures in all the cases strong,mediu
    %in the next line we calculate the time value of samples
    t = zeros(size(y,1),1);
    if(k==1) %conditionals to choose which input to choose
        U_input=U_input_1;
        disp('strong eco system')
    end
     if(k==2)
        U_input=U_input_2;
        disp('medium eco system')
     end
      if(k==3)
        U_input=U_input_3;
        disp('weak eco system')
```

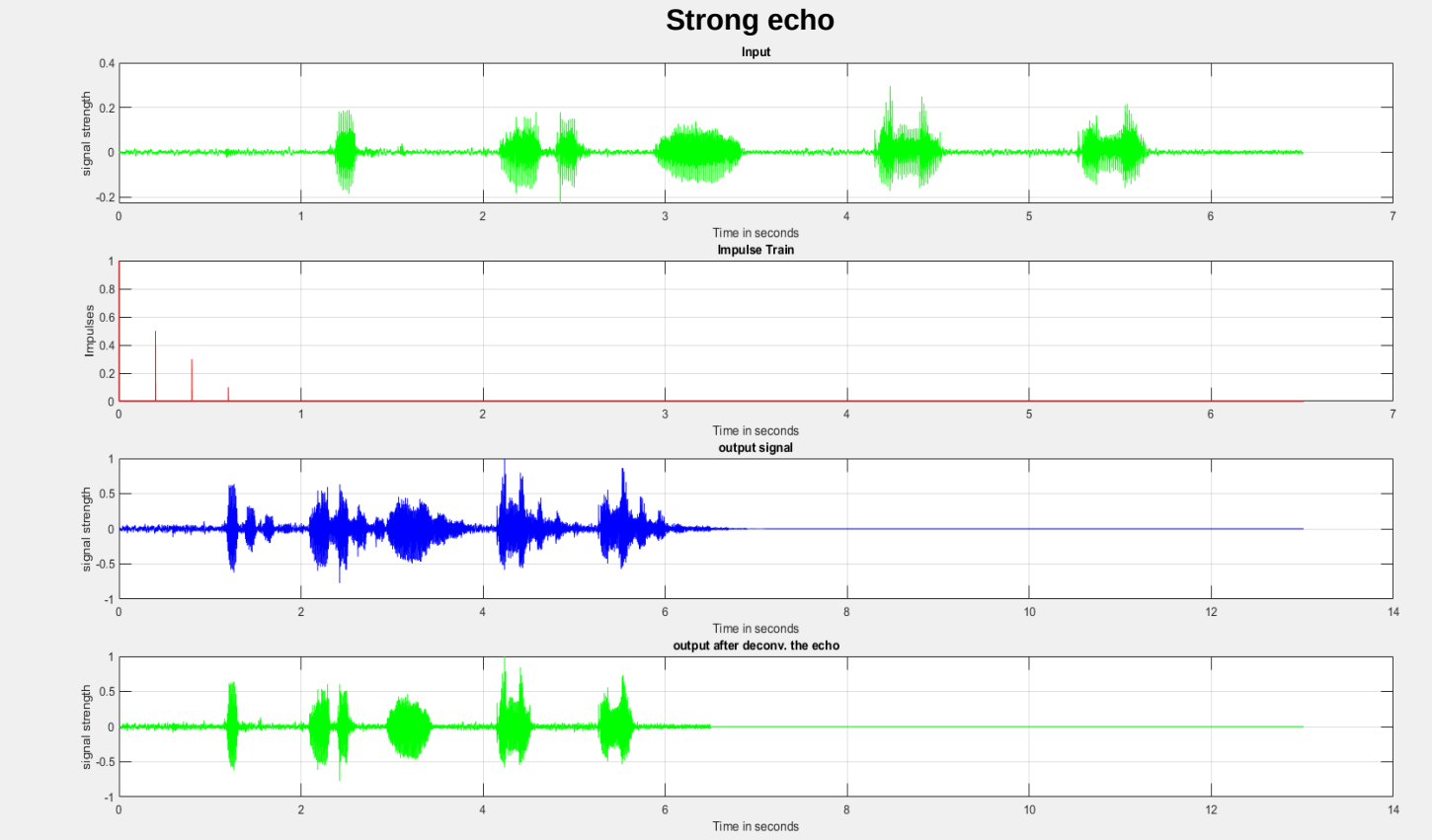
```
    end

    t(1)=1;

for i = 1:size(U_input,1)
    t(U_input(i,1)*Fs) = U_input(i,2); %for loop for defining the magnitude of each delta
end
figure(k);
% plot the input waveform
subplot(4,1,1);
plot(time,y,'g');
xlabel('Time in seconds')
ylabel('signal strength')
title('Input')
grid on


ly = length(y);
lt = length(t);
outlength = ly + lt - 1;
%performing FT so we can avoid convolution in the time domain between input
%and impulse response then IFT so we can restore the time domain version
y_out = ifft(fft(y, outlength) .* fft(t, outlength));
y_out = y_out./max(abs(y_out)); % Normalises Signal
```

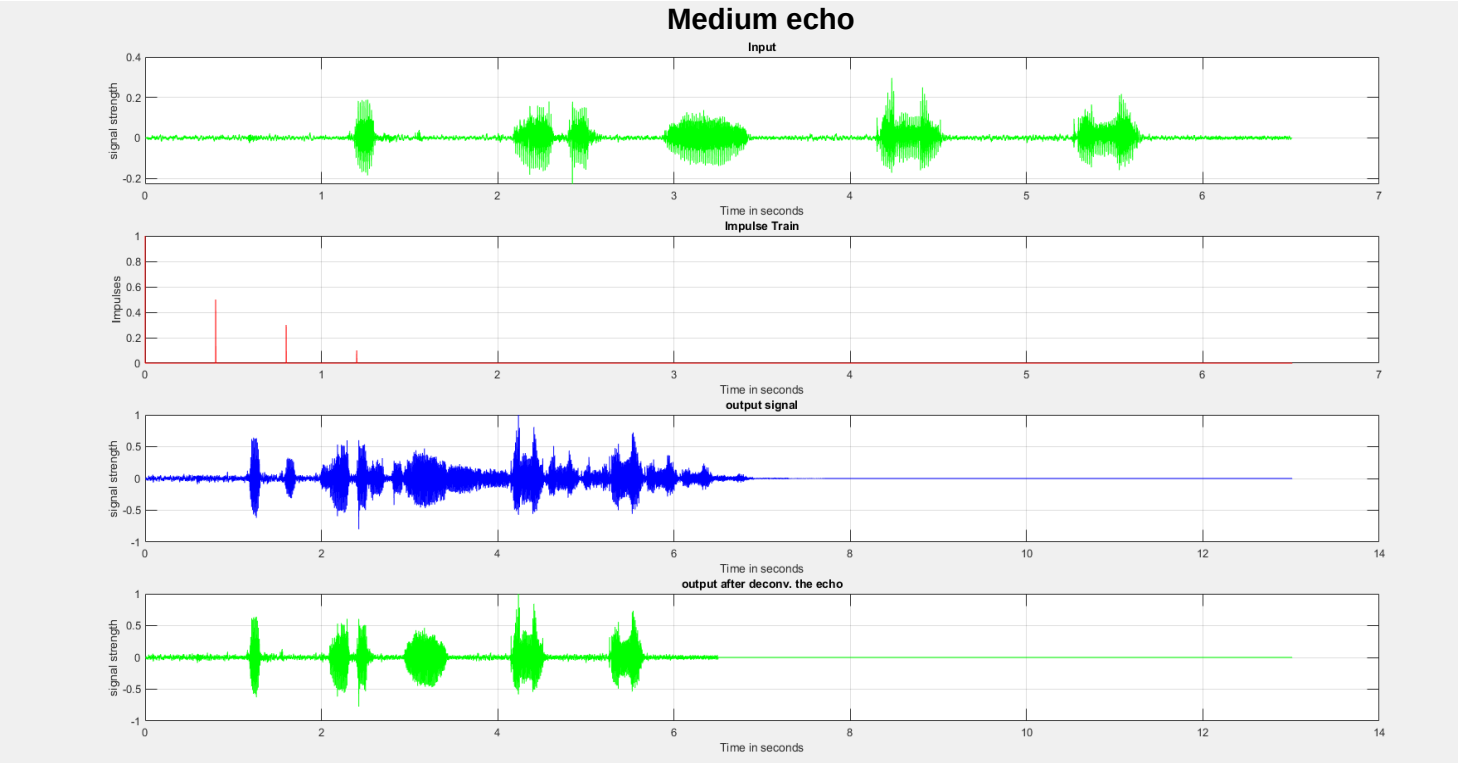
```
%plotting the impulse train
subplot(4,1,2);     %subplot is a function used to draw multiple figuers on the same window
plot(time,t,'r');
xlabel('Time in seconds')
ylabel('Impulses')
title('Impulse Train');
grid on


% Define the time axis of input
y_outlen=length(y_out);
time_axis_out = ([1:y_outlen]-1)/Fs;

subplot(4,1,3);
plot(time_axis_out,y_out,'b');
xlabel('Time in seconds')
ylabel('signal strength')
title('output signal');
```

- **Removing the echo from the signal**

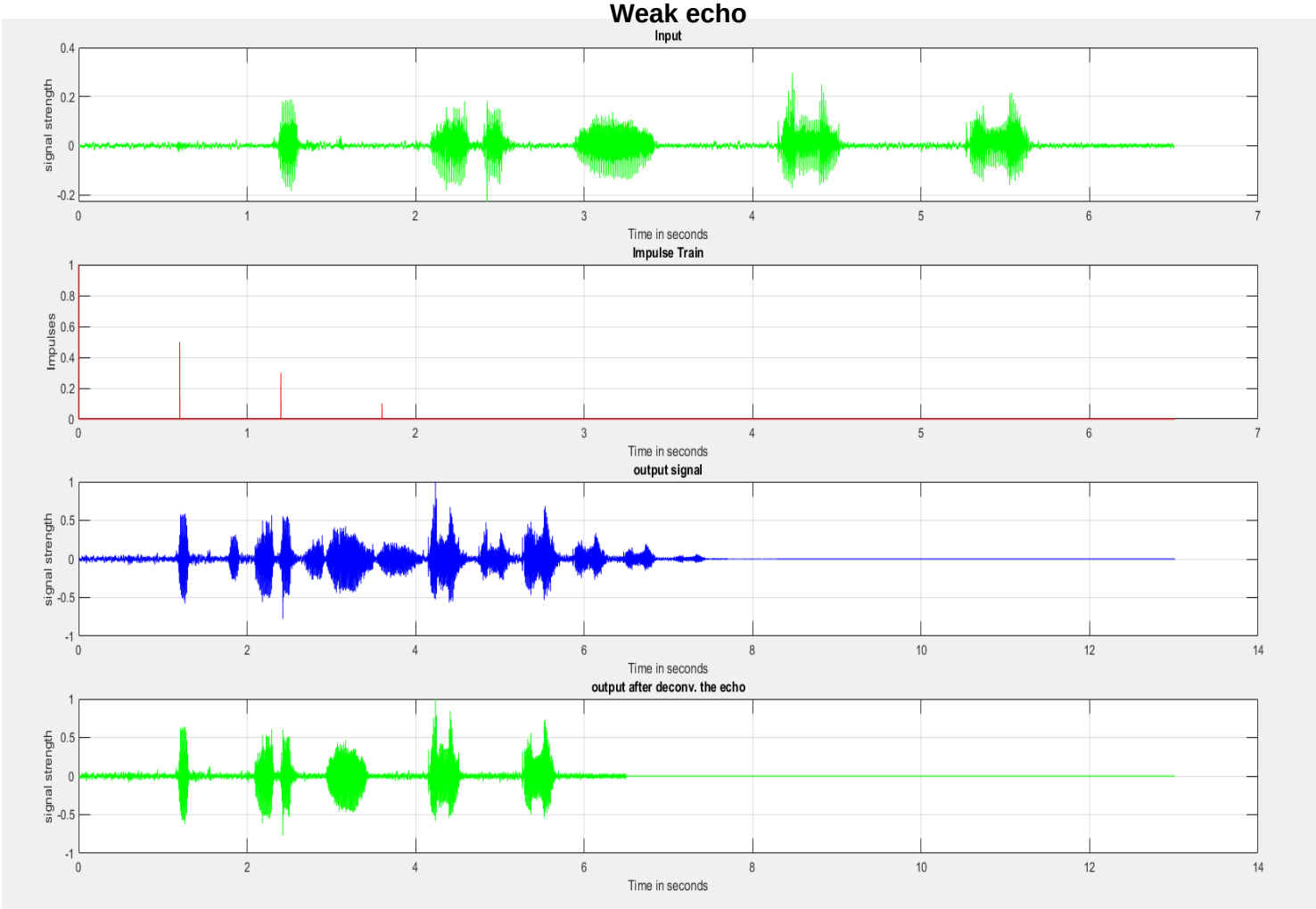
```
%plot the sound after applying the echo to it
subplot(4,1,3);
plot(time_axis_out,y_out,'b');
xlabel('Time in seconds')
ylabel('signal strength')
title('output signal');
grid on

%saving the output . wav file
%audiowrite('echo3.wav',y_out,Fs);


%getting the original signal by dividing the signal by the frequency
%response in the frequency domain
xx = ifft(fft(y_out,outlength)./fft(t, outlength));

%applying the deconv. by dividing the signal with the freq. response
%then getting the inverse fft to get the signal in the time domain
xx = xx./max(abs(xx)); %normalizing the signal


%plotting the signal after deconv.
subplot(4,1,4);
plot(time_axis_out,xx,'g');
xlabel('Time in seconds')
ylabel('signal strength')
title('output after deconv. the echo');
grid on

%playing the sound of the echoed signal
sound(y_out,Fs)
pause(T)

%playing the sound of the signal after removing the echo
sound(xx,Fs)
pause(T)

%saving the signal after removing the echo
%%audiowrite('de-echo3.wav',xx,Fs);


end
```

- **Output graphs:**





Weak echo


Input
signal strength
Time in seconds
Impulse Train
Impulses
Time in seconds
output signal
signal strength
Time in seconds
output after deconv. the echo
signal strength
Time in seconds