Appendix 1

1a: MATLAB .m file used to plot the damper characterization data captured using the MTS machine. It loads four data sets and outputs two plots

1b: MATLAB .m file used to test filtering technique to be applied to the acceleration data captured during vehicle testing

1c: MATLAB .m file used to load, filter, and decimate acceleration data. It also calculates summary information including finding the peak values of acceleration, the slope of the decay, and the RMS value of the acceleration for the time period around the first acceleration peak.

1d: MATLAB .m file used to load, filter, decimate acceleration data, and double integrate it to displacement. It also calculates summary information including finding the peak values of displacement, the slope of the decay, and the RMS value of the displacement for the time period around the first displacement peak.

1e: MATLAB .m file used to load, and filter acceleration data. The ffts of sparse data sets are averaged to come up with an averaged fft for the acceleration data.

1f: MATLAB .m file used to load the averaged fft of the acceleration data and calculate the average peak intensity in each of four frequency bands

Appendix 1a

-MATLAB .m file used to plot the damper characterization data captured using the MTS machine. It loads four data sets and outputs two plots

```
clear;
%%%%%      loading the data files  %%%%%%%%%%
load or110610.txt;      %%%% original damper data set
load mr110610.txt; load mr120610.txt; load mr130610.txt;
%    (+) velocity is extension
%    (+) force is tension


%%%%%              parsing          %%%%%%%%%%
vel(1:20,1)=-(or110610(20:-1:1,1));
vel(21:40,1)=or110610(:,1);

or(1:20,1)=or110610(20:-1:1,3); or(21:40,1)=or110610(:,2);

mr0(1:20,1)=mr110610(20:-1:1,3); mr0(21:40,1)=mr110610(:,2);
mr15(1:20,1)=mr120610(20:-1:1,3); mr15(21:40,1)=mr120610(:,2);
mr3(1:20,1)=mr130610(20:-1:1,3); mr3(21:40,1)=mr130610(:,2);
clear or110610; clear mr110610; clear mr120610; clear mr130610;

%%%%%              scaling          %%%%%%%%%%
vel=vel.*(20*pi); %%%%  velocity now in in/sec
or=or.*(2500/10);
mr0=mr0.*(5000/10);
mr15=mr15.*(5000/10);
mr3=mr3.*(5000/10); %%%%  forces now in lfb

%%%%%              graphing         %%%%%%%%%%
figure(1); clf;
subplot(2,1,1); plot(vel,or,'r-');
axis([-35 35 -2000 2000]); grid; hold on;
plot(vel,mr0,'y-'); plot(vel,mr3,'g-');
legend('r-','old','y-','c=0','g-','c=3');
ylabel('force (lbf)');
title('mr damper 1 tests mr(1-3)');

subplot(2,1,2); plot(vel,mr0,'y-');
axis([-35 35 -2000 2000]); grid; hold on;
plot(vel,mr15,'b-'); plot(vel, mr3,'g-');
legend('y-','c=0','b-','c=1.5','g-','c=3');
ylabel('force (lbf)');
xlabel('velocity (in/sec)');
```

Appendix 1b

-MATLAB .m file used to test filtering technique to be applied to the acceleration data captured during vehicle testing

```
fs=100; %sampling rate
f_low=1.0; f_high=15;
f=[0 f_low*2/fs f_low*2/fs f_high*2/fs f_high*2/fs 0];
H=[0 0 1 1 0 0];
fhz=f*fs/2;
n=50;
ff=fs/(2*n)*(0:n-1);
passband=[f_low*2/fs f_high*2/fs];
N=6; %order of filter
ripple=.1;
[Bc,Ac]=cheby1(N,ripple,passband);
h=[abs(freqz(Bc,Ac,n))];
figure(1); clf; plot(fhz,H,'y'); hold on; grid on; plot(ff,h,'b');
xlabel('frequency (Hz)'); ylabel('magnitude'); title('filter used');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%        generate  test signal
t=linspace(0,10,1000);
y1=2*exp(-1*t).*sin(4*2*pi*t);
y2=exp(-1.5*t).*cos(2*pi*20*t);
y3=2*exp(-.4*t).*sin(2*pi*.8*t);
y1(335:1000)=y1(1:666);
y1(1:334)=zeros(1,334);

y=y1+y2+y3;
yfil1=filter(Bc,Ac,y);
yfil2=filtfilt(Bc,Ac,y);

figure(2); subplot(211); plot(t,y1); title('signal by itself');
xlabel('time'); ylabel('signal'); subplot(212); plot(t,y);
title('signal "hidden"'); xlabel('time'); ylabel('signal');
figure(3); plot(t,y1,'r'); hold on; plot(t,yfil1,'g'); plot(t,yfil2,'b');
xlabel('time'); ylabel('signal'); title('filtered and original signal');

%%%% filtfilt most closely sticks to the original signal
```

Appendix 1c

-MATLAB .m file used to load, filter, and decimate acceleration data. It also calculates summary information including finding the peak values of acceleration, the slope of the decay, and the RMS value of the acceleration for the time period around the first acceleration peak.

```
clear; %change file number in 5 places
load dtest1.mat;
dtest=9.81.*dtest1;
clear dtest1;

fs=100; %sampling rate
f_low=1.0; f_high=15;
f=[0 f_low*2/fs f_low*2/fs f_high*2/fs f_high*2/fs 0];
H=[0 0 1 1 0 0];
fhz=f*fs/2;
n=50;
ff=fs/(2*n)*(0:n-1);
passband=[f_low*2/fs f_high*2/fs];
N=6; %order of filter
ripple=.1;
[Bc,Ac]=cheby1(N,ripple,passband);
h=[abs(freqz(Bc,Ac,n))];
%figure(12); clf; plot(fhz,H,'y'); hold on; grid on; plot(ff,h,'b');
%xlabel('frequency (Hz)'); ylabel('magnitude'); title('filter used');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

dtest(9:11,:)=10*dtest(9:11,:);
c1=dtest(1,:);
c2=dtest(2,:);
c3=dtest(3,:);
c4=dtest(4,:);
c5=dtest(5,:);
c6=dtest(6,:);
c7=dtest(7,:);
c8=dtest(8,:);
c9=dtest(9,:);
c10=dtest(10,:);
c11=dtest(11,:);
clear dtest;

%%%%%%%% decimating data
r=60;  % new sampling frequency is 100 hz
cc1=decimate(c1,r,'fir');
cc2=decimate(c2,r,'fir');
cc3=decimate(c3,r,'fir');
```

```
cc4=decimate(c4,r,'fir');
cc5=decimate(c5,r,'fir');
cc6=decimate(c6,r,'fir');
cc7=decimate(c7,r,'fir');
cc8=decimate(c8,r,'fir');
cc9=decimate(c9,r,'fir');
cc10=decimate(c10,r,'fir');
cc11=decimate(c11,r,'fir');
clear c1 c2 c3 c4 c5 c6 c7 c8 c9 c10 c11;

%%%%% apply digital filter
c1=filtfilt(Bc,Ac,cc1);
c2=filtfilt(Bc,Ac,cc2);
c3=filtfilt(Bc,Ac,cc3);
c4=filtfilt(Bc,Ac,cc4);
c5=filtfilt(Bc,Ac,cc5);
c6=filtfilt(Bc,Ac,cc6);
c7=filtfilt(Bc,Ac,cc7);
c8=filtfilt(Bc,Ac,cc8);
c9=filtfilt(Bc,Ac,cc9);
c10=filtfilt(Bc,Ac,cc10);
c11=filtfilt(Bc,Ac,cc11);

%%%  making the data mean zero
c1=c1-mean(c1);
c2=c2-mean(c2);
c3=c3-mean(c3);
c4=c4-mean(c4);
c5=c5-mean(c5);
c6=c6-mean(c6);
c7=c7-mean(c7);
c8=c8-mean(c8);
c9=c9-mean(c9);
c10=c10-mean(c10);
c11=c11-mean(c11);
%%%%%%% summary information
%       info=max1, max2, time1, time2, decay slope, rms for max+3
%       -rows correspond to channels
time=linspace(0,10,length(c1));
[a,b]=max(c1(50:length(c1))); b=b+49;
[e,f]=min(c1(1,b:b+75)); [c,d]=max(c1(1,f+b-1:b+75));
info(1,:)=[a c time(b) time(b+f+d-2)];
figure(1); clf; subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(c2(50:length(c2))); b=b+49;
[e,f]=min(c2(1,b:b+75)); [c,d]=max(c2(1,f+b-1:b+75));
```

```
info(2,:)=[a c time(b) time(b+f+d-2)];
figure(2); clf; subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(c3(50:length(c3))); b=b+49;
[e,f]=min(c3(1,b:b+75)); [c,d]=max(c3(1,f+b-1:b+75));
info(3,:)=[a c time(b) time(b+f+d-2)];
figure(3); clf; subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(c4(50:length(c4))); b=b+49;
[e,f]=min(c4(1,b:b+75)); [c,d]=max(c4(1,f+b-1:b+75));
info(4,:)=[a c time(b) time(b+f+d-2)];
figure(4); clf; subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(c5(50:length(c5))); b=b+49;
[e,f]=min(c5(1,b:b+75)); [c,d]=max(c5(1,f+b-1:b+75));
info(5,:)=[a c time(b) time(b+f+d-2)];
figure(5); clf; subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(c6(50:length(c6))); b=b+49;
[e,f]=min(c6(1,b:b+75)); [c,d]=max(c6(1,f+b-1:b+75));
info(6,:)=[a c time(b) time(b+f+d-2)];
figure(6); clf; subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(c7(50:length(c7))); b=b+49;
[e,f]=min(c7(1,b:b+75)); [c,d]=max(c7(1,f+b-1:b+75));
info(7,:)=[a c time(b) time(b+f+d-2)];
figure(7); clf; subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(c8(50:length(c8))); b=b+49;
[e,f]=min(c8(1,b:b+75)); [c,d]=max(c8(1,f+b-1:b+75));
info(8,:)=[a c time(b) time(b+f+d-2)];
figure(8); clf; subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(c9(50:length(c9))); b=b+49;
[e,f]=min(c9(1,b:b+75)); [c,d]=max(c9(1,f+b-1:b+75));
info(9,:)=[a c time(b) time(b+f+d-2)];
figure(9); clf; subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(c10(50:length(c10))); b=b+49;
[e,f]=min(c10(1,b:b+75)); [c,d]=max(c10(1,f+b-1:b+75));
info(10,:)=[a c time(b) time(b+f+d-2)];
figure(10); clf; subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(c11(50:length(c11))); b=b+49;
[e,f]=min(c11(1,b:b+75)); [c,d]=max(c11(1,f+b-1:b+75));
info(11,:)=[a c time(b) time(b+f+d-2)];
```

```
figure(11); clf; subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %

%%%%
for n=1:11;
        slope=(info(n,2)-info(n,1))/(info(n,4)-info(n,3));
  info(n,5)=slope;
end

%%%  info(n,6)=rms for max-1 sec to max -1,+2 sec
info(1,6)=sqrt(sum((c1(((info(1,3)*100)-100):((info(1,3)*100)+200))).^2)/300);
info(2,6)=sqrt(sum((c2(((info(2,3)*100)-100):((info(2,3)*100)+200))).^2)/300);
info(3,6)=sqrt(sum((c3(((info(3,3)*100)-100):((info(3,3)*100)+200))).^2)/300);
info(4,6)=sqrt(sum((c4(((info(4,3)*100)-100):((info(4,3)*100)+200))).^2)/300);
info(5,6)=sqrt(sum((c5(((info(5,3)*100)-100):((info(5,3)*100)+200))).^2)/300);
info(6,6)=sqrt(sum((c6(((info(6,3)*100)-100):((info(6,3)*100)+200))).^2)/300);
info(7,6)=sqrt(sum((c7(((info(7,3)*100)-100):((info(7,3)*100)+200))).^2)/300);
info(8,6)=sqrt(sum((c8(((info(8,3)*100)-100):((info(8,3)*100)+200))).^2)/300);
info(9,6)=sqrt(sum((c9(((info(9,3)*100)-100):((info(9,3)*100)+200))).^2)/300);
info(10,6)=sqrt(sum((c10(((info(10,3)*100)-100):((info(10,3)*100)+200))).^2)/300);
info(11,6)=sqrt(sum((c11(((info(11,3)*100)-100):((info(11,3)*100)+200))).^2)/300);

%%%%%%    plotting the acceleration data
figure(1); subplot(211); plot(time,cc1); ylabel('acceleration (m/s^2)');
xlabel('time (sec)'); grid on;title('unfiltered acceleration of channel 1');
subplot(212); plot(time,c1); title('filtered acceleration of channel 1');
ylabel('acceleration (m/s^2)'); xlabel('time (sec)'); grid on;
figure(2); subplot(211); plot(time,cc2); ylabel('acceleration (m/s^2)');
xlabel('time (sec)'); grid on;title('unfiltered acceleration of channel 2');
subplot(212); plot(time,c2); title('filtered acceleration of channel 2');
ylabel('acceleration (m/s^2)'); xlabel('time (sec)'); grid on;
figure(3); subplot(211); plot(time,cc3); ylabel('acceleation (m/s^2)');
xlabel('time (sec)'); grid on;title('unfiltered acceleration of channel 3');
subplot(212); plot(time,c3); title('filtered acceleration of channel 3');
ylabel('acceleration (m/s^2)'); xlabel('time (sec)'); grid on;
figure(4); subplot(211); plot(time,cc4); ylabel('acceleration (m/s^2)');
xlabel('time (sec)'); grid on;title('unfiltered acceleration of channel 4');
subplot(212); plot(time,c4); title('filtered acceleration of channel 4');
ylabel('acceleration (m/s^2)'); xlabel('time (sec)'); grid on;
figure(5); subplot(211); plot(time,cc5); ylabel('acceleration (m/s^2)');
xlabel('time (sec)'); grid on;title('unfiltered acceleration of channel 5');
subplot(212); plot(time,c5); title('filtered acceleration of channel 5');
ylabel('acceleration (m/s^2)'); xlabel('time (sec)'); grid on;
figure(6); subplot(211); plot(time,cc6); ylabel('acceleration (m/s^2)');
xlabel('time (sec)'); grid on;title('unfiltered acceleration of channel 6');
subplot(212); plot(time,c6); title('filtered acceleration of channel 6');
```

```
ylabel('acceleration (m/s^2)'); xlabel('time (sec)'); grid on;
figure(7); subplot(211); plot(time,cc7); ylabel('acceleration (m/s^2)');
xlabel('time (sec)'); grid on;title('unfiltered acceleration of channel 7');
subplot(212); plot(time,c7); title('filtered acceleration of channel 7');
ylabel('acceleration (m/s^2)'); xlabel('time (sec)'); grid on;
figure(8); subplot(211); plot(time,cc8); ylabel('acceleration (m/s^2)');
xlabel('time (sec)'); grid on;title('unfiltered acceleration of channel 8');
subplot(212); plot(time,c8); title('filtered acceleration of channel 8');
ylabel('acceleration (m/s^2)'); xlabel('time (sec)'); grid on;
figure(9); subplot(211); plot(time,cc9); ylabel('acceleration (m/s^2)');
xlabel('time (sec)'); grid on;title('unfiltered acceleration of channel 9');
subplot(212); plot(time,c9); title('filtered acceleration of channel 9');
ylabel('acceleration (m/s^2)'); xlabel('time (sec)'); grid on;
figure(10); subplot(211); plot(time,cc10); ylabel('acceleration (m/s^2)');
xlabel('time (sec)'); grid on;title('unfiltered acceleration of channel 10');
subplot(212); plot(time,c10); title('filtered acceleration of channel 10');
ylabel('acceleration (m/s^2)'); xlabel('time (sec)'); grid on;
figure(11); subplot(211); plot(time,cc11); ylabel('acceleration (m/s^2)');
xlabel('time (sec)'); grid on;title('unfiltered acceleration of channel 11');
subplot(212); plot(time,c11); title('filtered acceleration of channel 11');
ylabel('acceleration (m/s^2)'); xlabel('time (sec)'); grid on;

%%%  printing of the 11 plots;
%for n=1:11;
%figure(n); print
%end;

%%%  saving a file that contains the filtered/decimated accelerations of each channel
%save acc1 time c1 c2 c3 c4 c5 c6 c7 c8 c9 c10 c11;
%save info1 info
ending=linspace(0,1,1000); ending=sin(2*pi*ending*100); sound(ending);
```

Appendix 1d

-MATLAB .m file used to load, filter, decimate acceleration data, and double integrate it to displacement. It also calculates summary information including finding the peak values of displacement, the slope of the decay, and the RMS value of the displacement for the time period around the first displacement peak.

```
clear; %change file number in 5 places
load dtest1.mat;
dtest=9.81.*dtest1;
clear dtest1;

fs=100; %sampling rate
f_low=1.0; f_high=15;
f=[0 f_low*2/fs f_low*2/fs f_high*2/fs f_high*2/fs 0];
H=[0 0 1 1 0 0];
fhz=f*fs/2;
n=50;
ff=fs/(2*n)*(0:n-1);
passband=[f_low*2/fs f_high*2/fs];
N=6; %order of filter
ripple=.1;
[Bc,Ac]=cheby1(N,ripple,passband);
h=[abs(freqz(Bc,Ac,n))];
%figure(12); clf; plot(fhz,H,'y'); hold on; grid on; plot(ff,h,'b');
%xlabel('frequency (Hz)'); ylabel('magnitude'); title('filter used');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

dtest(9:11,:)=10*dtest(9:11,:);
c1=dtest(1,:);
c2=dtest(2,:);
c3=dtest(3,:);
c4=dtest(4,:);
c5=dtest(5,:);
c6=dtest(6,:);
c7=dtest(7,:);
c8=dtest(8,:);
c9=dtest(9,:);
c10=dtest(10,:);
c11=dtest(11,:);
clear dtest;

%%%%%%%% decimating data
r=60;  % new sampling frequency is 100 hz
cc1=decimate(c1,r,'fir');
cc2=decimate(c2,r,'fir');
```

```
cc3=decimate(c3,r,'fir');
cc4=decimate(c4,r,'fir');
cc5=decimate(c5,r,'fir');
cc6=decimate(c6,r,'fir');
cc7=decimate(c7,r,'fir');
cc8=decimate(c8,r,'fir');
cc9=decimate(c9,r,'fir');
cc10=decimate(c10,r,'fir');
cc11=decimate(c11,r,'fir');
clear c1 c2 c3 c4 c5 c6 c7 c8 c9 c10 c11;

%%%%% apply digital filter
c1=filtfilt(Bc,Ac,cc1);
c2=filtfilt(Bc,Ac,cc2);
c3=filtfilt(Bc,Ac,cc3);
c4=filtfilt(Bc,Ac,cc4);
c5=filtfilt(Bc,Ac,cc5);
c6=filtfilt(Bc,Ac,cc6);
c7=filtfilt(Bc,Ac,cc7);
c8=filtfilt(Bc,Ac,cc8);
c9=filtfilt(Bc,Ac,cc9);
c10=filtfilt(Bc,Ac,cc10);
c11=filtfilt(Bc,Ac,cc11);
clear cc1 cc2 cc3 cc4 cc5 cc6 cc7 cc8 cc9 cc10 cc11;

%%%  setting the first and last 100 pts of data to zero
c1(1:100)=zeros(1,100); c1((length(c1)-99):length(c1))=zeros(1,100);
c2(1:100)=zeros(1,100); c2((length(c2)-99):length(c2))=zeros(1,100);
c3(1:100)=zeros(1,100); c3((length(c3)-99):length(c3))=zeros(1,100);
c4(1:100)=zeros(1,100); c4((length(c4)-99):length(c4))=zeros(1,100);
c5(1:100)=zeros(1,100); c5((length(c5)-99):length(c5))=zeros(1,100);
c6(1:100)=zeros(1,100); c6((length(c6)-99):length(c6))=zeros(1,100);
c7(1:100)=zeros(1,100); c7((length(c7)-99):length(c7))=zeros(1,100);
c8(1:100)=zeros(1,100); c8((length(c8)-99):length(c8))=zeros(1,100);
c9(1:100)=zeros(1,100); c9((length(c9)-99):length(c9))=zeros(1,100);
c10(1:100)=zeros(1,100); c10((length(c10)-99):length(c10))=zeros(1,100);
c11(1:100)=zeros(1,100); c11((length(c11)-99):length(c11))=zeros(1,100);


%%%  making the data mean zero
c1=c1-mean(c1);
c2=c2-mean(c2);
c3=c3-mean(c3);
c4=c4-mean(c4);
c5=c5-mean(c5);
c6=c6-mean(c6);
```

```
c7=c7-mean(c7);
c8=c8-mean(c8);
c9=c9-mean(c9);
c10=c10-mean(c10);
c11=c11-mean(c11);

%%%%%%%%%%%%%%%%%%%%%%%%%%%% plotting subplot(211)
time=linspace(0,8,length(c1));
figure(1);clf; subplot(211); plot(time,c1); grid on
title('acceleration of channel 1'); xlabel('time (sec)'); ylabel('acceleration (m/s^2)');
figure(2);clf; subplot(211); plot(time,c2); grid on
title('acceleration of channel 2'); xlabel('time (sec)'); ylabel('acceleration (m/s^2)');
figure(3);clf; subplot(211); plot(time,c3); grid on
title('acceleration of channel 3'); xlabel('time (sec)'); ylabel('acceleration (m/s^2)');
figure(4);clf; subplot(211); plot(time,c4); grid on
title('acceleration of channel 4'); xlabel('time (sec)'); ylabel('acceleration (m/s^2)');
figure(5);clf; subplot(211); plot(time,c5); grid on
title('acceleration of channel 5'); xlabel('time (sec)'); ylabel('acceleration (m/s^2)');
figure(6);clf; subplot(211); plot(time,c6); grid on
title('acceleration of channel 6'); xlabel('time (sec)'); ylabel('acceleration (m/s^2)');
figure(7);clf; subplot(211); plot(time,c7); grid on
title('acceleration of channel 7'); xlabel('time (sec)'); ylabel('acceleration (m/s^2)');
figure(8);clf; subplot(211); plot(time,c8); grid on
title('acceleration of channel 8'); xlabel('time (sec)'); ylabel('acceleration (m/s^2)');
figure(9);clf; subplot(211); plot(time,c9); grid on
title('acceleration of channel 9'); xlabel('time (sec)'); ylabel('acceleration (m/s^2)');
figure(10);clf; subplot(211); plot(time,c10); grid on
title('acceleration of channel 10'); xlabel('time (sec)'); ylabel('acceleration (m/s^2)');
figure(11);clf; subplot(211); plot(time,c11); grid on
title('acceleration of channel 11'); xlabel('time (sec)'); ylabel('acceleration (m/s^2)');

%%%% ----------integration using LSIM and an integrator block ------
v1=lsim([1],[1 0],c1,time); v2=lsim([1],[1 0],c2,time);
v3=lsim([1],[1 0],c3,time); v4=lsim([1],[1 0],c4,time);
v5=lsim([1],[1 0],c5,time); v6=lsim([1],[1 0],c6,time);
v7=lsim([1],[1 0],c7,time); v8=lsim([1],[1 0],c8,time);
v9=lsim([1],[1 0],c9,time); v10=lsim([1],[1 0],c10,time);
v11=lsim([1],[1 0],c11,time);
v1=v1'; v2=v2'; v3=v3'; v4=v4'; v5=v5';
v6=v6'; v7=v7'; v8=v8'; v9=v9'; v10=v10'; v11=v11';

%%%  re-filter and mean zero
v1=filtfilt(Bc,Ac,v1);
v2=filtfilt(Bc,Ac,v2);
v3=filtfilt(Bc,Ac,v3);
v4=filtfilt(Bc,Ac,v4);
```

```
v5=filtfilt(Bc,Ac,v5);
v6=filtfilt(Bc,Ac,v6);
v7=filtfilt(Bc,Ac,v7);
v8=filtfilt(Bc,Ac,v8);
v9=filtfilt(Bc,Ac,v9);
v10=filtfilt(Bc,Ac,v10);
v11=filtfilt(Bc,Ac,v11);

%%%  setting the first and last 100 pts of data to zero
v1(1:100)=zeros(1,100); v1((length(v1)-99):length(v1))=zeros(1,100);
v2(1:100)=zeros(1,100); v2((length(v2)-99):length(v2))=zeros(1,100);
v3(1:100)=zeros(1,100); v3((length(v3)-99):length(v3))=zeros(1,100);
v4(1:100)=zeros(1,100); v4((length(v4)-99):length(v4))=zeros(1,100);
v5(1:100)=zeros(1,100); v5((length(v5)-99):length(v5))=zeros(1,100);
v6(1:100)=zeros(1,100); v6((length(v6)-99):length(v6))=zeros(1,100);
v7(1:100)=zeros(1,100); v7((length(v7)-99):length(v7))=zeros(1,100);
v8(1:100)=zeros(1,100); v8((length(v8)-99):length(v8))=zeros(1,100);
v9(1:100)=zeros(1,100); v9((length(v9)-99):length(v9))=zeros(1,100);
v10(1:100)=zeros(1,100); v10((length(v10)-99):length(v10))=zeros(1,100);
v11(1:100)=zeros(1,100); v11((length(v11)-99):length(v11))=zeros(1,100);


%%%  making the data mean zero
v1=v1-mean(v1);
v2=v2-mean(v2);
v3=v3-mean(v3);
v4=v4-mean(v4);
v5=v5-mean(v5);
v6=v6-mean(v6);
v7=v7-mean(v7);
v8=v8-mean(v8);
v9=v9-mean(v9);
v10=v10-mean(v10);
v11=v11-mean(v11);

d1=lsim([1],[1 0],v1,time); d2=lsim([1],[1 0],v2,time);
d3=lsim([1],[1 0],v3,time); d4=lsim([1],[1 0],v4,time);
d5=lsim([1],[1 0],v5,time); d6=lsim([1],[1 0],v6,time);
d7=lsim([1],[1 0],v7,time); d8=lsim([1],[1 0],v8,time);
d9=lsim([1],[1 0],v9,time); d10=lsim([1],[1 0],v10,time);
d11=lsim([1],[1 0],v11,time);
d1=d1'; d2=d2'; d3=d3'; d4=d4'; d5=d5';
d6=d6'; d7=d7'; d8=d8'; d9=d9'; d10=d10'; d11=d11';
%%%% ------------------------------------------------------------

%%%%%       getting summary data (to be saved in "dinfo#")
```

```
%       dinfo=max1, max2, time1, time2, decay slope, rms for max-1,+2
%       -rows correspond to channels
%  ^--- need to hit on max right after first max... maybe find
%      the min after first max, and then first max after that?

[a,b]=max(d1(50:length(d1))); b=b+49;
[e,f]=min(d1(1,b:b+75)); [c,d]=max(d1(1,f+b-1:b+f+75));
info(1,:)=[a c time(b) time(b+f+d-2)]; figure(1); subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(d2(50:length(d2))); b=b+49;
[e,f]=min(d2(1,b:b+75)); [c,d]=max(d2(1,f+b-1:b+f+75));
info(2,:)=[a c time(b) time(b+f+d-2)]; figure(2); subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(d3(50:length(d3))); b=b+49;
[e,f]=min(d3(1,b:b+75)); [c,d]=max(d3(1,f+b-1:b+f+75));
info(3,:)=[a c time(b) time(b+f+d-2)]; figure(3); subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(d4(50:length(d4))); b=b+49;
[e,f]=min(d4(1,b:b+75)); [c,d]=max(d4(1,f+b-1:b+f+75));
info(4,:)=[a c time(b) time(b+f+d-2)]; figure(4); subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(d5(50:length(d5))); b=b+49;
[e,f]=min(d5(1,b:b+75)); [c,d]=max(d5(1,f+b-1:b+f+75));
info(5,:)=[a c time(b) time(b+f+d-2)]; figure(5); subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(d6(50:length(d6))); b=b+49;
[e,f]=min(d6(1,b:b+75)); [c,d]=max(d6(1,f+b-1:b+f+75));
info(6,:)=[a c time(b) time(b+f+d-2)]; figure(6); subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(d7(50:length(d7))); b=b+49;
[e,f]=min(d7(1,b:b+75)); [c,d]=max(d7(1,f+b-1:b+f+75));
info(7,:)=[a c time(b) time(b+f+d-2)]; figure(7); subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(d8(50:length(d8))); b=b+49;
[e,f]=min(d8(1,b:b+75)); [c,d]=max(d8(1,f+b-1:b+f+75));
info(8,:)=[a c time(b) time(b+f+d-2)]; figure(8); subplot(212);
[a,b]=max(d9(50:length(d9))); b=b+49;
[e,f]=min(d9(1,b:b+75)); [c,d]=max(d9(1,f+b-1:b+f+75));
info(9,:)=[a c time(b) time(b+f+d-2)]; figure(9); subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(d10(50:length(d10))); b=b+49;
[e,f]=min(d10(1,b:b+75)); [c,d]=max(d10(1,f+b-1:b+f+75));
nfo(10,:)=[a c time(b) time(b+f+d-2)]; figure(10); subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %
[a,b]=max(d11(50:length(d11))); b=b+49;
[e,f]=min(d11(1,b:b+75)); [c,d]=max(d11(1,f+b-1:b+f+75));
```

```
info(11,:)=[a c time(b) time(b+f+d-2)]; figure(11); subplot(212);
plot([time(b) time(b+f+d-2)],[a c],'y'); hold on; %

%%%%
for n=1:11;
        slope=(info(n,2)-info(n,1))/(info(n,4)-info(n,3));
  info(n,5)=slope;
end

%%%  info(n,6)=rms for max-1 sec to max +2 sec
info(1,6)=sqrt(sum((d1(((info(1,3)*100)-100):((info(1,3)*100)+200))).^2)/300);
info(2,6)=sqrt(sum((d2(((info(2,3)*100)-100):((info(2,3)*100)+200))).^2)/300);
info(3,6)=sqrt(sum((d3(((info(3,3)*100)-100):((info(3,3)*100)+200))).^2)/300);
info(4,6)=sqrt(sum((d4(((info(4,3)*100)-100):((info(4,3)*100)+200))).^2)/300);
info(5,6)=sqrt(sum((d5(((info(5,3)*100)-100):((info(5,3)*100)+200))).^2)/300);
info(6,6)=sqrt(sum((d6(((info(6,3)*100)-100):((info(6,3)*100)+200))).^2)/300);
info(7,6)=sqrt(sum((d7(((info(7,3)*100)-100):((info(7,3)*100)+200))).^2)/300);
info(8,6)=sqrt(sum((d8(((info(8,3)*100)-100):((info(8,3)*100)+200))).^2)/300);
info(9,6)=sqrt(sum((d9(((info(9,3)*100)-100):((info(9,3)*100)+200))).^2)/300);
info(10,6)=sqrt(sum((d10(((info(10,3)*100)-100):((info(10,3)*100)+200))).^2)/300);
info(11,6)=sqrt(sum((d11(((info(11,3)*100)-100):((info(11,3)*100)+200))).^2)/300);


%%%%         plotting subplot(212) --- (displacement)
figure(1); subplot(212); plot(time,d1); title('displacement; channel 1');
xlabel('time (sec)'); ylabel('displacement (m)'); grid on;
figure(2); subplot(212); plot(time,d2); title('displacement; channel 2');
xlabel('time (sec)'); ylabel('displacement (m)'); grid on;
figure(3); subplot(212); plot(time,d3); title('displacement; channel 3');
xlabel('time (sec)'); ylabel('displacement (m)'); grid on;
figure(4); subplot(212); plot(time,d4); title('displacement; channel 4');
xlabel('time (sec)'); ylabel('displacement (m)'); grid on;
figure(5); subplot(212); plot(time,d5); title('displacement; channel 5');
xlabel('time (sec)'); ylabel('displacement (m)'); grid on;
figure(6); subplot(212); plot(time,d6); title('displacement; channel 6');
xlabel('time (sec)'); ylabel('displacement (m)'); grid on;
figure(7); subplot(212); plot(time,d7); title('displacement; channel 7');
xlabel('time (sec)'); ylabel('displacement (m)'); grid on;
figure(8); subplot(212); plot(time,d8); title('displacement; channel 8');
xlabel('time (sec)'); ylabel('displacement (m)'); grid on;
figure(9); subplot(212); plot(time,d9); title('displacement; channel 9');
xlabel('time (sec)'); ylabel('displacement (m)'); grid on;
figure(10); subplot(212); plot(time,d10); title('displacement; channel 10');
xlabel('time (sec)'); ylabel('displacement (m)'); grid on;
figure(11); subplot(212); plot(time,d11); title('displacement; channel 11');
xlabel('time (sec)'); ylabel('displacement (m)'); grid on;
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%  printing of the 11 plots;
%for n=1:11;
%figure(n); print
%end;


%save disp1 d1 d2 d3 d4 d5 d6 d7 d8 d9 d10 d11;
%save dinfo1 info;

ending=linspace(0,1,1000); ending=sin(2*pi*ending*100); sound(ending);
```

Appendix 1e

-MATLAB .m file used to load, and filter acceleration data. The ffts of sparse data sets are averaged to come up with an averaged fft for the acceleration data.

```
%%% file used to load and decimate all 11 channels of a data set;
%%%  it does it for 20 data sets, each starting 3 elements off
%%%  of the previous
%%%  -this is to come up with an averaged fft, without using the
%%%   typical block averaging, since we don't want to lose the
%%%   time dependency of the signal.
%%%  -the fft of each of these 10 data sets will then be averaged
%%%   to get a true fft, which can then be integrated.
clear; r=60; %1/r is decimation rate
%%%  this program decimates and digitally filters the data
%%%  for r=60, the highest frequency that we will see is 50 hz
%%%  (sampling at 100 hz)
load dtest20.mat; dtest20=98.1.*dtest20;  % loading and multiplying by  98.1
                                          % to convert from V to m/s^2
c1=dtest20(1,:);
c2=dtest20(2,:);
c3=dtest20(3,:);
c4=dtest20(4,:);
c5=dtest20(5,:);
c6=dtest20(6,:);
c7=dtest20(7,:);
c8=dtest20(8,:);
c9=dtest20(9,:);
c10=dtest20(10,:);
c11=dtest20(11,:);

%%%  from this point on is starting file independent, except
%%%   for the save and clear statements at the end of the file.

%%%  making the data mean zero
c1=c1-mean(c1);
c2=c2-mean(c2);
c3=c3-mean(c3);
c4=c4-mean(c4);
c5=c5-mean(c5);
c6=c6-mean(c6);
c7=c7-mean(c7);
c8=c8-mean(c8);
c9=c9-mean(c9);
c10=c10-mean(c10);
c11=c11-mean(c11);
```

```
%%%  building multiple data sets for averaging
for n=1:1:20;
cc1(n,:)=decimate(c1,r,'fir'); c1(1,1:length(c1)-3)=c1(1,4:length(c1));
c1(1,length(c1))=0; c1(1,length(c1)-1)=0; c1(1,length(c1)-2)=0;
cc2(n,:)=decimate(c2,r,'fir'); c2(1,1:length(c2)-3)=c2(1,4:length(c2));
c2(1,length(c2))=0; c2(1,length(c2)-1)=0; c2(1,length(c2)-2)=0;
cc3(n,:)=decimate(c3,r,'fir'); c3(1,1:length(c3)-3)=c3(1,4:length(c3));
c3(1,length(c3))=0; c3(1,length(c3)-1)=0; c3(1,length(c3)-2)=0;
cc4(n,:)=decimate(c4,r,'fir'); c4(1,1:length(c4)-3)=c4(1,4:length(c4));
c4(1,length(c4))=0; c4(1,length(c4)-1)=0; c4(1,length(c4)-2)=0;
cc5(n,:)=decimate(c5,r,'fir'); c5(1,1:length(c5)-3)=c5(1,4:length(c5));
c5(1,length(c5))=0; c5(1,length(c5)-1)=0; c5(1,length(c5)-2)=0;
cc6(n,:)=decimate(c6,r,'fir'); c6(1,1:length(c6)-3)=c6(1,4:length(c6));
c6(1,length(c6))=0; c6(1,length(c6)-1)=0; c6(1,length(c6)-2)=0;
cc7(n,:)=decimate(c7,r,'fir'); c7(1,1:length(c7)-3)=c7(1,4:length(c7));
c7(1,length(c7))=0; c7(1,length(c7)-1)=0; c7(1,length(c7)-2)=0;
cc8(n,:)=decimate(c8,r,'fir'); c8(1,1:length(c8)-3)=c8(1,4:length(c8));
c8(1,length(c8))=0; c8(1,length(c8)-1)=0; c8(1,length(c8)-2)=0;
cc9(n,:)=decimate(c9,r,'fir'); c9(1,1:length(c9)-3)=c9(1,4:length(c9));
c9(1,length(c9))=0; c9(1,length(c9)-1)=0; c9(1,length(c9)-2)=0;
cc10(n,:)=decimate(c10,r,'fir'); c10(1,1:length(c10)-3)=c10(1,4:length(c10));
c10(1,length(c10))=0; c10(1,length(c10)-1)=0; c10(1,length(c10)-2)=0;
cc11(n,:)=decimate(c11,r,'fir'); c11(1,1:length(c11)-3)=c11(1,4:length(c11));
c11(1,length(c11))=0; c11(1,length(c11)-1)=0; c11(1,length(c11)-2)=0;
end; clear new2; clear n; clear r; clear c1; clear c2; clear c3; clear c4;
clear c5; clear c6; clear c7; clear c8; clear c9; clear c10; clear c11;
fft1=zeros(1,length(cc1)); fft2=zeros(1,length(cc2)); fft3=zeros(1,length(cc3));
fft4=zeros(1,length(cc4)); fft5=zeros(1,length(cc5)); fft6=zeros(1,length(cc6));
fft7=zeros(1,length(cc7)); fft8=zeros(1,length(cc8)); fft9=zeros(1,length(cc9));
fft10=zeros(1,length(cc10)); fft11=zeros(1,length(cc11));
for n=1:1:20;
fftemp1=fft(cc1(n,:)); fft1=fft1+.05*fftemp1;
fftemp2=fft(cc2(n,:)); fft2=fft2+.05*fftemp2;
fftemp3=fft(cc3(n,:)); fft3=fft3+.05*fftemp3;
fftemp4=fft(cc4(n,:)); fft4=fft4+.05*fftemp4;
fftemp5=fft(cc5(n,:)); fft5=fft5+.05*fftemp5;
fftemp6=fft(cc6(n,:)); fft6=fft6+.05*fftemp6;
fftemp7=fft(cc7(n,:)); fft7=fft7+.05*fftemp7;
fftemp8=fft(cc8(n,:)); fft8=fft8+.05*fftemp8;
fftemp9=fft(cc9(n,:)); fft9=fft9+.05*fftemp9;
fftemp10=fft(cc10(n,:)); fft10=fft10+.05*fftemp10;
fftemp11=fft(cc11(n,:)); fft11=fft11+.05*fftemp11;
end;
clear fftemp1; clear fftemp2; clear fftemp3; clear fftemp4; clear fftemp5; clear fftemp6;
```

```
clear fftemp7; clear fftemp8; clear fftemp9; clear fftemp10; clear fftemp11;
clear cc1; clear cc2; clear cc3; clear cc4; clear cc5; clear cc6;
clear cc7; clear cc8; clear cc9; clear cc10; clear cc11; clear n;

%%%%%%%%        plotting of averaged fft of each channel
%%%  note: 100 below is only for a decimation of 60
%%%       (2./length(fftn))is to  scale it, but only on the
%%%         plot, not in the actual data
%%%       only plotting for the first have (single sided)

freq=linspace(0,(length(fft1)-1)*100/length(fft1),length(fft1));
figure(1); plot(freq,(2./length(fft1)).*abs(fft1));
title('fft of channel 1'); xlabel('frequency (hz)');
ylabel('magnitude (m/s^2)'); axis([0 50 0 30]); grid on
figure(2); plot(freq,(2./length(fft2)).*abs(fft2));
title('fft of channel 2'); xlabel('frequency (hz)');
ylabel('magnitude (m/s^2)'); axis([0 50 0 30]); grid on
figure(3); plot(freq,(2./length(fft3)).*abs(fft3));
title('fft of channel 3'); xlabel('frequency (hz)');
ylabel('magnitude (m/s^2)'); axis([0 50 0 30]); grid on
figure(4); plot(freq,(2./length(fft4)).*abs(fft4));
title('fft of channel 4'); xlabel('frequency (hz)');
ylabel('magnitude (m/s^2)'); axis([0 50 0 30]); grid on
figure(5); plot(freq,(2./length(fft5)).*abs(fft5));
title('fft of channel 5'); xlabel('frequency (hz)');
ylabel('magnitude (m/s^2)'); axis([0 50 0 30]); grid on
figure(6); plot(freq,(2./length(fft6)).*abs(fft6));
title('fft of channel 6'); xlabel('frequency (hz)');
ylabel('magnitude (m/s^2)'); axis([0 50 0 30]); grid on
figure(7); plot(freq,(2./length(fft7)).*abs(fft7));
title('fft of channel 7'); xlabel('frequency (hz)');
ylabel('magnitude (m/s^2)'); axis([0 50 0 30]); grid on
figure(8); plot(freq,(2./length(fft8)).*abs(fft8));
title('fft of channel 8'); xlabel('frequency (hz)');
ylabel('magnitude (m/s^2)'); axis([0 50 0 30]); grid on
figure(9); plot(freq,(2./length(fft9)).*abs(fft9));
title('fft of channel 9'); xlabel('frequency (hz)');
ylabel('magnitude (m/s^2)'); axis([0 50 0 5]); grid on
figure(10); plot(freq,(2./length(fft10)).*abs(fft10));
title('fft of channel 10'); xlabel('frequency (hz)');
ylabel('magnitude (m/s^2)'); axis([0 50 0 5]); grid on
figure(11); plot(freq,(2./length(fft11)).*abs(fft11));
title('fft of channel 11'); xlabel('frequency (hz)');
ylabel('magnitude (m/s^2)'); axis([0 50 0 5]); grid on;

%%%  printing of the 11 plots;
```

```
%for n=1:11;
%figure(n); print
%end;

%%%  saving a file that contains the averaged fft of each channel
clear dtest20
save d20m0;

ending=linspace(0,1,1000); ending=sin(2*pi*ending*100); sound(ending);
```

Appendix 1f

-MATLAB .m file used to load the averaged fft of the acceleration data and calculate the average peak intensity in each of four frequency bands

```
%       program that loads the averaged fft of the acceleration for each channel and then
%       averages across like data sets.  This ends up producing four sets of eleven
%       channels of data.  Each of the four sets represents one of the configurations, that
%       is dampers on, off, SA, and original.
%       the program then breaks the ffts into freq. bands. and produces data for four plots
%       of eleven sets of four bars representing the peak average intensity.
clear;
afft1=0; afft2=0; afft3=0; afft4=0; afft5=0; afft6=0;
afft7=0; afft8=0; afft9=0; afft10=0; afft11=0;
bfft1=0; bfft2=0; bfft3=0; bfft4=0; bfft5=0; bfft6=0;
bfft7=0; bfft8=0; bfft9=0; bfft10=0; bfft11=0;
cfft1=0; cfft2=0; cfft3=0; cfft4=0; cfft5=0; cfft6=0;
cfft7=0; cfft8=0; cfft9=0; cfft10=0; cfft11=0;
dfft1=0; dfft2=0; dfft3=0; dfft4=0; dfft5=0; dfft6=0;
dfft7=0; dfft8=0; dfft9=0; dfft10=0; dfft11=0;
%       (a=active, b=3A, c=0A, d=original)

load d1m0; clear freq n;
afft1=afft1+(1/80)*fft1; afft2=afft2+(1/80)*fft2; afft3=afft3+(1/80)*fft3;
afft4=afft4+(1/80)*fft4; afft5=afft5+(1/80)*fft5; afft6=afft6+(1/80)*fft6;
afft7=afft7+(1/80)*fft7; afft8=afft8+(1/80)*fft8; afft9=afft9+(1/8)*fft9;
afft10=afft10+(1/8)*fft10; afft11=afft11+(1/8)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d2m0; clear freq n;
afft1=afft1+(1/80)*fft1; afft2=afft2+(1/80)*fft2; afft3=afft3+(1/80)*fft3;
afft4=afft4+(1/80)*fft4; afft5=afft5+(1/80)*fft5; afft6=afft6+(1/80)*fft6;
afft7=afft7+(1/80)*fft7; afft8=afft8+(1/80)*fft8; afft9=afft9+(1/8)*fft9;
afft10=afft10+(1/8)*fft10; afft11=afft11+(1/8)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d3m0; clear freq n;
afft1=afft1+(1/80)*fft1; afft2=afft2+(1/80)*fft2; afft3=afft3+(1/80)*fft3;
afft4=afft4+(1/80)*fft4; afft5=afft5+(1/80)*fft5; afft6=afft6+(1/80)*fft6;
afft7=afft7+(1/80)*fft7; afft8=afft8+(1/80)*fft8; afft9=afft9+(1/8)*fft9;
afft10=afft10+(1/8)*fft10; afft11=afft11+(1/8)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

%load d4m0; clear freq n;
%afft1=afft1+(1/90)*fft1; afft2=afft2+(1/90)*fft2; afft3=afft3+(1/90)*fft3;
%afft4=afft4+(1/90)*fft4; afft5=afft5+(1/90)*fft5; afft6=afft6+(1/90)*fft6;
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%afft7=afft7+(1/90)*fft7; afft8=afft8+(1/90)*fft8; afft9=afft9+(1/9)*fft9;
%afft10=afft10+(1/9)*fft10; afft11=afft11+(1/9)*fft11;
%clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d5m0; clear freq n;
afft1=afft1+(1/80)*fft1; afft2=afft2+(1/80)*fft2; afft3=afft3+(1/80)*fft3;
afft4=afft4+(1/80)*fft4; afft5=afft5+(1/80)*fft5; afft6=afft6+(1/80)*fft6;
afft7=afft7+(1/80)*fft7; afft8=afft8+(1/80)*fft8; afft9=afft9+(1/8)*fft9;
afft10=afft10+(1/8)*fft10; afft11=afft11+(1/8)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d6m0; clear freq n;
afft1=afft1+(1/80)*fft1; afft2=afft2+(1/80)*fft2; afft3=afft3+(1/80)*fft3;
afft4=afft4+(1/80)*fft4; afft5=afft5+(1/80)*fft5; afft6=afft6+(1/80)*fft6;
afft7=afft7+(1/80)*fft7; afft8=afft8+(1/80)*fft8; afft9=afft9+(1/8)*fft9;
afft10=afft10+(1/8)*fft10; afft11=afft11+(1/8)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d7m0; clear freq n;
afft1=afft1+(1/80)*fft1; afft2=afft2+(1/80)*fft2; afft3=afft3+(1/80)*fft3;
afft4=afft4+(1/80)*fft4; afft5=afft5+(1/80)*fft5; afft6=afft6+(1/80)*fft6;
afft7=afft7+(1/80)*fft7; afft8=afft8+(1/80)*fft8; afft9=afft9+(1/8)*fft9;
afft10=afft10+(1/8)*fft10; afft11=afft11+(1/8)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d8m0; clear freq n;
afft1=afft1+(1/80)*fft1; afft2=afft2+(1/80)*fft2; afft3=afft3+(1/80)*fft3;
afft4=afft4+(1/80)*fft4; afft5=afft5+(1/80)*fft5; afft6=afft6+(1/80)*fft6;
afft7=afft7+(1/80)*fft7; afft8=afft8+(1/80)*fft8; afft9=afft9+(1/8)*fft9;
afft10=afft10+(1/8)*fft10; afft11=afft11+(1/8)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d9m0;
afft1=afft1+(1/80)*fft1; afft2=afft2+(1/80)*fft2; afft3=afft3+(1/80)*fft3;
afft4=afft4+(1/80)*fft4; afft5=afft5+(1/80)*fft5; afft6=afft6+(1/80)*fft6;
afft7=afft7+(1/80)*fft7; afft8=afft8+(1/80)*fft8; afft9=afft9+(1/8)*fft9;
afft10=afft10+(1/8)*fft10; afft11=afft11+(1/8)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

frq=linspace(0,(length(afft1)-1)*100/length(afft1),length(afft1));
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%
load d12m0; clear freq n;
bfft1=bfft1+(1/50)*fft1; bfft2=afft2+(1/50)*fft2; bfft3=bfft3+(1/50)*fft3;
bfft4=bfft4+(1/50)*fft4; bfft5=afft5+(1/50)*fft5; bfft6=bfft6+(1/50)*fft6;
bfft7=bfft7+(1/50)*fft7; bfft8=afft8+(1/50)*fft8; bfft9=bfft9+(1/5)*fft9;
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bfft10=bfft10+(1/5)*fft10; bfft11=afft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d13m0; clear freq n;
bfft1=bfft1+(1/50)*fft1; bfft2=afft2+(1/50)*fft2; bfft3=bfft3+(1/50)*fft3;
bfft4=bfft4+(1/50)*fft4; bfft5=afft5+(1/50)*fft5; bfft6=bfft6+(1/50)*fft6;
bfft7=bfft7+(1/50)*fft7; bfft8=afft8+(1/50)*fft8; bfft9=bfft9+(1/5)*fft9;
bfft10=bfft10+(1/5)*fft10; bfft11=afft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d14m0; clear freq n;
bfft1=bfft1+(1/50)*fft1; bfft2=afft2+(1/50)*fft2; bfft3=bfft3+(1/50)*fft3;
bfft4=bfft4+(1/50)*fft4; bfft5=afft5+(1/50)*fft5; bfft6=bfft6+(1/50)*fft6;
bfft7=bfft7+(1/50)*fft7; bfft8=afft8+(1/50)*fft8; bfft9=bfft9+(1/5)*fft9;
bfft10=bfft10+(1/5)*fft10; bfft11=afft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d16m0; clear freq n;
bfft1=bfft1+(1/50)*fft1; bfft2=afft2+(1/50)*fft2; bfft3=bfft3+(1/50)*fft3;
bfft4=bfft4+(1/50)*fft4; bfft5=afft5+(1/50)*fft5; bfft6=bfft6+(1/50)*fft6;
bfft7=bfft7+(1/50)*fft7; bfft8=afft8+(1/50)*fft8; bfft9=bfft9+(1/5)*fft9;
bfft10=bfft10+(1/5)*fft10; bfft11=afft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d17m0; clear freq n;
bfft1=bfft1+(1/50)*fft1; bfft2=afft2+(1/50)*fft2; bfft3=bfft3+(1/50)*fft3;
bfft4=bfft4+(1/50)*fft4; bfft5=afft5+(1/50)*fft5; bfft6=bfft6+(1/50)*fft6;
bfft7=bfft7+(1/50)*fft7; bfft8=afft8+(1/50)*fft8; bfft9=bfft9+(1/5)*fft9;
bfft10=bfft10+(1/5)*fft10; bfft11=afft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%
load d18m0; clear freq n;
cfft1=cfft1+(1/50)*fft1; cfft2=cfft2+(1/50)*fft2; cfft3=cfft3+(1/50)*fft3;
cfft4=cfft4+(1/50)*fft4; cfft5=cfft5+(1/50)*fft5; cfft6=cfft6+(1/50)*fft6;
cfft7=cfft7+(1/50)*fft7; cfft8=cfft8+(1/50)*fft8; cfft9=cfft9+(1/5)*fft9;
cfft10=cfft10+(1/5)*fft10; cfft11=cfft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d19m0; clear freq n;
cfft1=cfft1+(1/50)*fft1; cfft2=cfft2+(1/50)*fft2; cfft3=cfft3+(1/50)*fft3;
cfft4=cfft4+(1/50)*fft4; cfft5=cfft5+(1/50)*fft5; cfft6=cfft6+(1/50)*fft6;
cfft7=cfft7+(1/50)*fft7; cfft8=cfft8+(1/50)*fft8; cfft9=cfft9+(1/5)*fft9;
cfft10=cfft10+(1/5)*fft10; cfft11=cfft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;
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load d20m0; clear freq n;
cfft1=cfft1+(1/50)*fft1; cfft2=cfft2+(1/50)*fft2; cfft3=cfft3+(1/50)*fft3;
cfft4=cfft4+(1/50)*fft4; cfft5=cfft5+(1/50)*fft5; cfft6=cfft6+(1/50)*fft6;
cfft7=cfft7+(1/50)*fft7; cfft8=cfft8+(1/50)*fft8; cfft9=cfft9+(1/5)*fft9;
cfft10=cfft10+(1/5)*fft10; cfft11=cfft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d21m0; clear freq n;
cfft1=cfft1+(1/50)*fft1; cfft2=cfft2+(1/50)*fft2; cfft3=cfft3+(1/50)*fft3;
cfft4=cfft4+(1/50)*fft4; cfft5=cfft5+(1/50)*fft5; cfft6=cfft6+(1/50)*fft6;
cfft7=cfft7+(1/50)*fft7; cfft8=cfft8+(1/50)*fft8; cfft9=cfft9+(1/5)*fft9;
cfft10=cfft10+(1/5)*fft10; cfft11=cfft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d22m0; clear freq n;
cfft1=cfft1+(1/50)*fft1; cfft2=cfft2+(1/50)*fft2; cfft3=cfft3+(1/50)*fft3;
cfft4=cfft4+(1/50)*fft4; cfft5=cfft5+(1/50)*fft5; cfft6=cfft6+(1/50)*fft6;
cfft7=cfft7+(1/50)*fft7; cfft8=cfft8+(1/50)*fft8; cfft9=cfft9+(1/5)*fft9;
cfft10=cfft10+(1/5)*fft10; cfft11=cfft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%
load d23m0; clear freq n;
dfft1=dfft1+(1/50)*fft1; dfft2=dfft2+(1/50)*fft2; dfft3=dfft3+(1/50)*fft3;
dfft4=dfft4+(1/50)*fft4; dfft5=dfft5+(1/50)*fft5; dfft6=dfft6+(1/50)*fft6;
dfft7=dfft7+(1/50)*fft7; dfft8=dfft8+(1/50)*fft8; dfft9=dfft9+(1/5)*fft9;
dfft10=dfft10+(1/5)*fft10; dfft11=dfft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d24m0; clear freq n;
dfft1=dfft1+(1/50)*fft1; dfft2=dfft2+(1/50)*fft2; dfft3=dfft3+(1/50)*fft3;
dfft4=dfft4+(1/50)*fft4; dfft5=dfft5+(1/50)*fft5; dfft6=dfft6+(1/50)*fft6;
dfft7=dfft7+(1/50)*fft7; dfft8=dfft8+(1/50)*fft8; dfft9=dfft9+(1/5)*fft9;
dfft10=dfft10+(1/5)*fft10; dfft11=dfft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d25m0; clear freq n;
dfft1=dfft1+(1/50)*fft1; dfft2=dfft2+(1/50)*fft2; dfft3=dfft3+(1/50)*fft3;
dfft4=dfft4+(1/50)*fft4; dfft5=dfft5+(1/50)*fft5; dfft6=dfft6+(1/50)*fft6;
dfft7=dfft7+(1/50)*fft7; dfft8=dfft8+(1/50)*fft8; dfft9=dfft9+(1/5)*fft9;
dfft10=dfft10+(1/5)*fft10; dfft11=dfft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d26m0; clear freq n;
dfft1=dfft1+(1/50)*fft1; dfft2=dfft2+(1/50)*fft2; dfft3=dfft3+(1/50)*fft3;
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dfft4=dfft4+(1/50)*fft4; dfft5=dfft5+(1/50)*fft5; dfft6=dfft6+(1/50)*fft6;
dfft7=dfft7+(1/50)*fft7; dfft8=dfft8+(1/50)*fft8; dfft9=dfft9+(1/5)*fft9;
dfft10=dfft10+(1/5)*fft10; dfft11=dfft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d28m0; clear freq n;
dfft1=dfft1+(1/50)*fft1; dfft2=dfft2+(1/50)*fft2; dfft3=dfft3+(1/50)*fft3;
dfft4=dfft4+(1/50)*fft4; dfft5=dfft5+(1/50)*fft5; dfft6=dfft6+(1/50)*fft6;
dfft7=dfft7+(1/50)*fft7; dfft8=dfft8+(1/50)*fft8; dfft9=dfft9+(1/5)*fft9;
dfft10=dfft10+(1/5)*fft10; dfft11=dfft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

load d29m0; clear freq n;
dfft1=dfft1+(1/50)*fft1; dfft2=dfft2+(1/50)*fft2; dfft3=dfft3+(1/50)*fft3;
dfft4=dfft4+(1/50)*fft4; dfft5=dfft5+(1/50)*fft5; dfft6=dfft6+(1/50)*fft6;
dfft7=dfft7+(1/50)*fft7; dfft8=dfft8+(1/50)*fft8; dfft9=dfft9+(1/5)*fft9;
dfft10=dfft10+(1/5)*fft10; dfft11=dfft11+(1/5)*fft11;
clear fft1 fft2 fft3 fft4 fft5 fft6 fft7 fft8 fft9 fft10 fft11;

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%
figure(1);
plot(frq,(2./length(afft1)).*abs(afft1),'b'); hold on;
%plot(frq,(2./length(bfft1)).*abs(bfft1),'g');
%plot(frq,(2./length(cfft1)).*abs(cfft1),'y');
plot(frq,(2./length(dfft1)).*abs(dfft1),'r');
title('averaged fft of channel 1'); xlabel('frequency (hz)');
ylabel('magnitude (m/s^2)'); axis([1 5 0 .25]); grid on;

figure(2);
plot(frq,(2./length(afft2)).*abs(afft2),'b'); hold on;
%plot(frq,(2./length(bfft2)).*abs(bfft2),'g');
%plot(frq,(2./length(cfft2)).*abs(cfft2),'y');
plot(frq,(2./length(dfft2)).*abs(dfft2),'r');
title('averaged fft of channel 2'); xlabel('frequency (Hz)');
ylabel('magnitude (m/s^2)'); axis([1 5 0 .25]); grid on;

figure(3);
plot(frq,(2./length(afft3)).*abs(afft3),'b'); hold on;
%plot(frq,(2./length(bfft3)).*abs(bfft3),'g');
%plot(frq,(2./length(cfft3)).*abs(cfft3),'y');
plot(frq,(2./length(dfft3)).*abs(dfft3),'r');
title('averaged fft of channel 3'); xlabel('frequency (Hz)');
ylabel('magnitude (m/s^2)'); axis([1 5 0 .25]); grid on;

figure(4);
```

```
plot(frq,(2./length(afft4)).*abs(afft4),'b'); hold on;
%plot(frq,(2./length(bfft4)).*abs(bfft4),'g');
%plot(frq,(2./length(cfft4)).*abs(cfft4),'y');
plot(frq,(2./length(dfft4)).*abs(dfft4),'r');
title('averaged fft of channel 4'); xlabel('frequency (Hz)');
ylabel('magnitude (m/s^2)'); axis([1 5 0 .25]); grid on;

figure(5);
plot(frq,(2./length(afft5)).*abs(afft5),'b'); hold on;
%plot(frq,(2./length(bfft5)).*abs(bfft5),'g');
%plot(frq,(2./length(cfft5)).*abs(cfft5),'y');
plot(frq,(2./length(dfft5)).*abs(dfft5),'r');
title('averaged fft of channel 5'); xlabel('frequency (Hz)');
ylabel('magnitude (m/s^2)'); axis([1 5 0 .25]); grid on;

figure(6);
plot(frq,(2./length(afft6)).*abs(afft6),'b'); hold on;
%plot(frq,(2./length(bfft6)).*abs(bfft6),'g');
%plot(frq,(2./length(cfft6)).*abs(cfft6),'y');
plot(frq,(2./length(dfft6)).*abs(dfft6),'r');
title('averaged fft of channel 6'); xlabel('frequency (Hz)');
ylabel('magnitude (m/s^2)'); axis([1 5 0 .25]); grid on;

figure(7);
plot(frq,(2./length(afft7)).*abs(afft7),'b'); hold on;
%plot(frq,(2./length(bfft7)).*abs(bfft7),'g');
%plot(frq,(2./length(cfft7)).*abs(cfft7),'y');
plot(frq,(2./length(dfft7)).*abs(dfft7),'r');
title('averaged fft of channel 7'); xlabel('frequency (Hz)');
ylabel('magnitude (m/s^2)'); axis([1 5 0 .25]); grid on;

figure(8);
plot(frq,(2./length(afft8)).*abs(afft8),'b'); hold on;
%plot(frq,(2./length(bfft8)).*abs(bfft8),'g');
%plot(frq,(2./length(cfft8)).*abs(cfft8),'y');
plot(frq,(2./length(dfft8)).*abs(dfft8),'r');
title('averaged fft of channel 8'); xlabel('frequency (Hz)');
ylabel('magnitude (m/s^2)'); axis([1 5 0 .25]); grid on;

figure(9);
plot(frq,(2./length(afft9)).*abs(afft9),'b'); hold on;
%plot(frq,(2./length(bfft9)).*abs(bfft9),'g');
%plot(frq,(2./length(cfft9)).*abs(cfft9),'y');
plot(frq,(2./length(dfft9)).*abs(dfft9),'r');
title('averaged fft of channel 9'); xlabel('frequency (Hz)');
ylabel('magnitude (m/s^2)'); axis([1 5 0 .25]); grid on;
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figure(10);
plot(frq,(2./length(afft10)).*abs(afft10),'b'); hold on;
%plot(frq,(2./length(bfft10)).*abs(bfft10),'g');
%plot(frq,(2./length(cfft10)).*abs(cfft10),'y');
plot(frq,(2./length(dfft10)).*abs(dfft10),'r');
title('averaged fft of channel 10'); xlabel('frequency (Hz)');
ylabel('magnitude (m/s^2)'); axis([1 5 0 .25]); grid on;

figure(11);
plot(frq,(2./length(afft11)).*abs(afft11),'b'); hold on;
%plot(frq,(2./length(bfft11)).*abs(bfft11),'g');
%plot(frq,(2./length(cfft11)).*abs(cfft11),'y');
plot(frq,(2./length(dfft11)).*abs(dfft11),'r');
title('averaged fft of channel 11'); xlabel('frequency (Hz)');
ylabel('magnitude (m/s^2)'); axis([1 5 0 .25]); grid on;

%       bands: 1=1-4 hz, 2=4-9 hz, 3=9-14 hz, 4=14-19 hz
%       working with afft
%       aapi(band,channel)
aapi(1,1)=(3/(41^2))*(2./length(afft1))*sum(abs(afft1(1:41)));
aapi(1,2)=(3/(41^2))*(2./length(afft2))*sum(abs(afft2(1:41)));
aapi(1,3)=(3/(41^2))*(2./length(afft3))*sum(abs(afft3(1:41)));
aapi(1,4)=(3/(41^2))*(2./length(afft4))*sum(abs(afft4(1:41)));
aapi(1,5)=(3/(41^2))*(2./length(afft5))*sum(abs(afft5(1:41)));
aapi(1,6)=(3/(41^2))*(2./length(afft6))*sum(abs(afft6(1:41)));
aapi(1,7)=(3/(41^2))*(2./length(afft7))*sum(abs(afft7(1:41)));
aapi(1,8)=(3/(41^2))*(2./length(afft8))*sum(abs(afft8(1:41)));
aapi(1,9)=(3/(41^2))*(2./length(afft9))*sum(abs(afft9(1:41)));
aapi(1,10)=(3/(41^2))*(2./length(afft10))*sum(abs(afft10(1:41)));
aapi(1,11)=(3/(41^2))*(2./length(afft11))*sum(abs(afft11(1:41)));

aapi(2,1)=(5/(51^2))*(2./length(afft1))*sum(abs(afft1(41:91)));
aapi(2,2)=(5/(51^2))*(2./length(afft2))*sum(abs(afft2(41:91)));
aapi(2,3)=(5/(51^2))*(2./length(afft3))*sum(abs(afft3(41:91)));
aapi(2,4)=(5/(51^2))*(2./length(afft4))*sum(abs(afft4(41:91)));
aapi(2,5)=(5/(51^2))*(2./length(afft5))*sum(abs(afft5(41:91)));
aapi(2,6)=(5/(51^2))*(2./length(afft6))*sum(abs(afft6(41:91)));
aapi(2,7)=(5/(51^2))*(2./length(afft7))*sum(abs(afft7(41:91)));
aapi(2,8)=(5/(51^2))*(2./length(afft8))*sum(abs(afft8(41:91)));
aapi(2,9)=(5/(51^2))*(2./length(afft9))*sum(abs(afft9(41:91)));
aapi(2,10)=(5/(51^2))*(2./length(afft10))*sum(abs(afft10(41:91)));
aapi(2,11)=(5/(51^2))*(2./length(afft11))*sum(abs(afft11(41:91)));

aapi(3,1)=(5/(51^2))*(2./length(afft1))*sum(abs(afft1(91:141)));
aapi(3,2)=(5/(51^2))*(2./length(afft2))*sum(abs(afft2(91:141)));
```

```
aapi(3,3)=(5/(51^2))*(2./length(afft3))*sum(abs(afft3(91:141)));
aapi(3,4)=(5/(51^2))*(2./length(afft4))*sum(abs(afft4(91:141)));
aapi(3,5)=(5/(51^2))*(2./length(afft5))*sum(abs(afft5(91:141)));
aapi(3,6)=(5/(51^2))*(2./length(afft6))*sum(abs(afft6(91:141)));
aapi(3,7)=(5/(51^2))*(2./length(afft7))*sum(abs(afft7(91:141)));
aapi(3,8)=(5/(51^2))*(2./length(afft8))*sum(abs(afft8(91:141)));
aapi(3,9)=(5/(51^2))*(2./length(afft9))*sum(abs(afft9(91:141)));
aapi(3,10)=(5/(51^2))*(2./length(afft10))*sum(abs(afft10(91:141)));
aapi(3,11)=(5/(51^2))*(2./length(afft11))*sum(abs(afft11(91:141)));

aapi(4,1)=(5/(51^2))*(2./length(afft1))*sum(abs(afft1(141:191)));
aapi(4,2)=(5/(51^2))*(2./length(afft2))*sum(abs(afft2(141:191)));
aapi(4,3)=(5/(51^2))*(2./length(afft3))*sum(abs(afft3(141:191)));
aapi(4,4)=(5/(51^2))*(2./length(afft4))*sum(abs(afft4(141:191)));
aapi(4,5)=(5/(51^2))*(2./length(afft5))*sum(abs(afft5(141:191)));
aapi(4,6)=(5/(51^2))*(2./length(afft6))*sum(abs(afft6(141:191)));
aapi(4,7)=(5/(51^2))*(2./length(afft7))*sum(abs(afft7(141:191)));
aapi(4,8)=(5/(51^2))*(2./length(afft8))*sum(abs(afft8(141:191)));
aapi(4,9)=(5/(51^2))*(2./length(afft9))*sum(abs(afft9(141:191)));
aapi(4,10)=(5/(51^2))*(2./length(afft10))*sum(abs(afft10(141:191)));
aapi(4,11)=(5/(51^2))*(2./length(afft11))*sum(abs(afft11(141:191)));

%       working with bfft
bapi(1,1)=(3/(41^2))*(2./length(bfft1))*sum(abs(bfft1(1:41)));
bapi(1,2)=(3/(41^2))*(2./length(bfft2))*sum(abs(bfft2(1:41)));
bapi(1,3)=(3/(41^2))*(2./length(bfft3))*sum(abs(bfft3(1:41)));
bapi(1,4)=(3/(41^2))*(2./length(bfft4))*sum(abs(bfft4(1:41)));
bapi(1,5)=(3/(41^2))*(2./length(bfft5))*sum(abs(bfft5(1:41)));
bapi(1,6)=(3/(41^2))*(2./length(bfft6))*sum(abs(bfft6(1:41)));
bapi(1,7)=(3/(41^2))*(2./length(bfft7))*sum(abs(bfft7(1:41)));
bapi(1,8)=(3/(41^2))*(2./length(bfft8))*sum(abs(bfft8(1:41)));
bapi(1,9)=(3/(41^2))*(2./length(bfft9))*sum(abs(bfft9(1:41)));
bapi(1,10)=(3/(41^2))*(2./length(bfft10))*sum(abs(bfft10(1:41)));
bapi(1,11)=(3/(41^2))*(2./length(bfft11))*sum(abs(bfft11(1:41)));

bapi(2,1)=(5/(51^2))*(2./length(bfft1))*sum(abs(bfft1(41:91)));
bapi(2,2)=(5/(51^2))*(2./length(bfft2))*sum(abs(bfft2(41:91)));
bapi(2,3)=(5/(51^2))*(2./length(bfft3))*sum(abs(bfft3(41:91)));
bapi(2,4)=(5/(51^2))*(2./length(bfft4))*sum(abs(bfft4(41:91)));
bapi(2,5)=(5/(51^2))*(2./length(bfft5))*sum(abs(bfft5(41:91)));
bapi(2,6)=(5/(51^2))*(2./length(bfft6))*sum(abs(bfft6(41:91)));
bapi(2,7)=(5/(51^2))*(2./length(bfft7))*sum(abs(bfft7(41:91)));
bapi(2,8)=(5/(51^2))*(2./length(bfft8))*sum(abs(bfft8(41:91)));
bapi(2,9)=(5/(51^2))*(2./length(bfft9))*sum(abs(bfft9(41:91)));
bapi(2,10)=(5/(51^2))*(2./length(bfft10))*sum(abs(bfft10(41:91)));
bapi(2,11)=(5/(51^2))*(2./length(bfft11))*sum(abs(bfft11(41:91)));
```

```
bapi(3,1)=(5/(51^2))*(2./length(bfft1))*sum(abs(bfft1(91:141)));
bapi(3,2)=(5/(51^2))*(2./length(bfft2))*sum(abs(bfft2(91:141)));
bapi(3,3)=(5/(51^2))*(2./length(bfft3))*sum(abs(bfft3(91:141)));
bapi(3,4)=(5/(51^2))*(2./length(bfft4))*sum(abs(bfft4(91:141)));
bapi(3,5)=(5/(51^2))*(2./length(bfft5))*sum(abs(bfft5(91:141)));
bapi(3,6)=(5/(51^2))*(2./length(bfft6))*sum(abs(bfft6(91:141)));
bapi(3,7)=(5/(51^2))*(2./length(bfft7))*sum(abs(bfft7(91:141)));
bapi(3,8)=(5/(51^2))*(2./length(bfft8))*sum(abs(bfft8(91:141)));
bapi(3,9)=(5/(51^2))*(2./length(bfft9))*sum(abs(bfft9(91:141)));
bapi(3,10)=(5/(51^2))*(2./length(bfft10))*sum(abs(bfft10(91:141)));
bapi(3,11)=(5/(51^2))*(2./length(bfft11))*sum(abs(bfft11(91:141)));

bapi(4,1)=(5/(51^2))*(2./length(bfft1))*sum(abs(bfft1(141:191)));
bapi(4,2)=(5/(51^2))*(2./length(bfft2))*sum(abs(bfft2(141:191)));
bapi(4,3)=(5/(51^2))*(2./length(bfft3))*sum(abs(bfft3(141:191)));
bapi(4,4)=(5/(51^2))*(2./length(bfft4))*sum(abs(bfft4(141:191)));
bapi(4,5)=(5/(51^2))*(2./length(bfft5))*sum(abs(bfft5(141:191)));
bapi(4,6)=(5/(51^2))*(2./length(bfft6))*sum(abs(bfft6(141:191)));
bapi(4,7)=(5/(51^2))*(2./length(bfft7))*sum(abs(bfft7(141:191)));
bapi(4,8)=(5/(51^2))*(2./length(bfft8))*sum(abs(bfft8(141:191)));
bapi(4,9)=(5/(51^2))*(2./length(bfft9))*sum(abs(bfft9(141:191)));
bapi(4,10)=(5/(51^2))*(2./length(bfft10))*sum(abs(bfft10(141:191)));
bapi(4,11)=(5/(51^2))*(2./length(bfft11))*sum(abs(bfft11(141:191)));

%       working with cff1
capi(1,1)=(3/(41^2))*(2./length(cfft1))*sum(abs(cfft1(1:41)));
capi(1,2)=(3/(41^2))*(2./length(cfft2))*sum(abs(cfft2(1:41)));
capi(1,3)=(3/(41^2))*(2./length(cfft3))*sum(abs(cfft3(1:41)));
capi(1,4)=(3/(41^2))*(2./length(cfft4))*sum(abs(cfft4(1:41)));
capi(1,5)=(3/(41^2))*(2./length(cfft5))*sum(abs(cfft5(1:41)));
capi(1,6)=(3/(41^2))*(2./length(cfft6))*sum(abs(cfft6(1:41)));
capi(1,7)=(3/(41^2))*(2./length(cfft7))*sum(abs(cfft7(1:41)));
capi(1,8)=(3/(41^2))*(2./length(cfft8))*sum(abs(cfft8(1:41)));
capi(1,9)=(3/(41^2))*(2./length(cfft9))*sum(abs(cfft9(1:41)));
capi(1,10)=(3/(41^2))*(2./length(cfft10))*sum(abs(cfft10(1:41)));
capi(1,11)=(3/(41^2))*(2./length(cfft11))*sum(abs(cfft11(1:41)));

capi(2,1)=(5/(51^2))*(2./length(cfft1))*sum(abs(cfft1(41:91)));
capi(2,2)=(5/(51^2))*(2./length(cfft2))*sum(abs(cfft2(41:91)));
capi(2,3)=(5/(51^2))*(2./length(cfft3))*sum(abs(cfft3(41:91)));
capi(2,4)=(5/(51^2))*(2./length(cfft4))*sum(abs(cfft4(41:91)));
capi(2,5)=(5/(51^2))*(2./length(cfft5))*sum(abs(cfft5(41:91)));
capi(2,6)=(5/(51^2))*(2./length(cfft6))*sum(abs(cfft6(41:91)));
capi(2,7)=(5/(51^2))*(2./length(cfft7))*sum(abs(cfft7(41:91)));
capi(2,8)=(5/(51^2))*(2./length(cfft8))*sum(abs(cfft8(41:91)));
```

```
capi(2,9)=(5/(51^2))*(2./length(cfft9))*sum(abs(cfft9(41:91)));
capi(2,10)=(5/(51^2))*(2./length(cfft10))*sum(abs(cfft10(41:91)));
capi(2,11)=(5/(51^2))*(2./length(cfft11))*sum(abs(cfft11(41:91)));

capi(3,1)=(5/(51^2))*(2./length(cfft1))*sum(abs(cfft1(91:141)));
capi(3,2)=(5/(51^2))*(2./length(cfft2))*sum(abs(cfft2(91:141)));
capi(3,3)=(5/(51^2))*(2./length(cfft3))*sum(abs(cfft3(91:141)));
capi(3,4)=(5/(51^2))*(2./length(cfft4))*sum(abs(cfft4(91:141)));
capi(3,5)=(5/(51^2))*(2./length(cfft5))*sum(abs(cfft5(91:141)));
capi(3,6)=(5/(51^2))*(2./length(cfft6))*sum(abs(cfft6(91:141)));
capi(3,7)=(5/(51^2))*(2./length(cfft7))*sum(abs(cfft7(91:141)));
capi(3,8)=(5/(51^2))*(2./length(cfft8))*sum(abs(cfft8(91:141)));
capi(3,9)=(5/(51^2))*(2./length(cfft9))*sum(abs(cfft9(91:141)));
capi(3,10)=(5/(51^2))*(2./length(cfft10))*sum(abs(cfft10(91:141)));
capi(3,11)=(5/(51^2))*(2./length(cfft11))*sum(abs(cfft11(91:141)));

capi(4,1)=(5/(51^2))*(2./length(cfft1))*sum(abs(cfft1(141:191)));
capi(4,2)=(5/(51^2))*(2./length(cfft2))*sum(abs(cfft2(141:191)));
capi(4,3)=(5/(51^2))*(2./length(cfft3))*sum(abs(cfft3(141:191)));
capi(4,4)=(5/(51^2))*(2./length(cfft4))*sum(abs(cfft4(141:191)));
capi(4,5)=(5/(51^2))*(2./length(cfft5))*sum(abs(cfft5(141:191)));
capi(4,6)=(5/(51^2))*(2./length(cfft6))*sum(abs(cfft6(141:191)));
capi(4,7)=(5/(51^2))*(2./length(cfft7))*sum(abs(cfft7(141:191)));
capi(4,8)=(5/(51^2))*(2./length(cfft8))*sum(abs(cfft8(141:191)));
capi(4,9)=(5/(51^2))*(2./length(cfft9))*sum(abs(cfft9(141:191)));
capi(4,10)=(5/(51^2))*(2./length(cfft10))*sum(abs(cfft10(141:191)));
capi(4,11)=(5/(51^2))*(2./length(cfft11))*sum(abs(cfft11(141:191)));

%       working with dfft
dapi(1,1)=(3/(41^2))*(2./length(dfft1))*sum(abs(dfft1(1:41)));
dapi(1,2)=(3/(41^2))*(2./length(dfft2))*sum(abs(dfft2(1:41)));
dapi(1,3)=(3/(41^2))*(2./length(dfft3))*sum(abs(dfft3(1:41)));
dapi(1,4)=(3/(41^2))*(2./length(dfft4))*sum(abs(dfft4(1:41)));
dapi(1,5)=(3/(41^2))*(2./length(dfft5))*sum(abs(dfft5(1:41)));
dapi(1,6)=(3/(41^2))*(2./length(dfft6))*sum(abs(dfft6(1:41)));
dapi(1,7)=(3/(41^2))*(2./length(dfft7))*sum(abs(dfft7(1:41)));
dapi(1,8)=(3/(41^2))*(2./length(dfft8))*sum(abs(dfft8(1:41)));
dapi(1,9)=(3/(41^2))*(2./length(dfft9))*sum(abs(dfft9(1:41)));
dapi(1,10)=(3/(41^2))*(2./length(dfft10))*sum(abs(dfft10(1:41)));
dapi(1,11)=(3/(41^2))*(2./length(dfft11))*sum(abs(dfft11(1:41)));

dapi(2,1)=(5/(51^2))*(2./length(dfft1))*sum(abs(dfft1(41:91)));
dapi(2,2)=(5/(51^2))*(2./length(dfft2))*sum(abs(dfft2(41:91)));
dapi(2,3)=(5/(51^2))*(2./length(dfft3))*sum(abs(dfft3(41:91)));
dapi(2,4)=(5/(51^2))*(2./length(dfft4))*sum(abs(dfft4(41:91)));
dapi(2,5)=(5/(51^2))*(2./length(dfft5))*sum(abs(dfft5(41:91)));
```

```
dapi(2,6)=(5/(51^2))*(2./length(dfft6))*sum(abs(dfft6(41:91)));
dapi(2,7)=(5/(51^2))*(2./length(dfft7))*sum(abs(dfft7(41:91)));
dapi(2,8)=(5/(51^2))*(2./length(dfft8))*sum(abs(dfft8(41:91)));
dapi(2,9)=(5/(51^2))*(2./length(dfft9))*sum(abs(dfft9(41:91)));
dapi(2,10)=(5/(51^2))*(2./length(dfft10))*sum(abs(dfft10(41:91)));
dapi(2,11)=(5/(51^2))*(2./length(dfft11))*sum(abs(dfft11(41:91)));

dapi(3,1)=(5/(51^2))*(2./length(dfft1))*sum(abs(dfft1(91:141)));
dapi(3,2)=(5/(51^2))*(2./length(dfft2))*sum(abs(dfft2(91:141)));
dapi(3,3)=(5/(51^2))*(2./length(dfft3))*sum(abs(dfft3(91:141)));
dapi(3,4)=(5/(51^2))*(2./length(dfft4))*sum(abs(dfft4(91:141)));
dapi(3,5)=(5/(51^2))*(2./length(dfft5))*sum(abs(dfft5(91:141)));
dapi(3,6)=(5/(51^2))*(2./length(dfft6))*sum(abs(dfft6(91:141)));
dapi(3,7)=(5/(51^2))*(2./length(dfft7))*sum(abs(dfft7(91:141)));
dapi(3,8)=(5/(51^2))*(2./length(dfft8))*sum(abs(dfft8(91:141)));
dapi(3,9)=(5/(51^2))*(2./length(dfft9))*sum(abs(dfft9(91:141)));
dapi(3,10)=(5/(51^2))*(2./length(dfft10))*sum(abs(dfft10(91:141)));
dapi(3,11)=(5/(51^2))*(2./length(dfft11))*sum(abs(dfft11(91:141)));

dapi(4,1)=(5/(51^2))*(2./length(dfft1))*sum(abs(dfft1(141:191)));
dapi(4,2)=(5/(51^2))*(2./length(dfft2))*sum(abs(dfft2(141:191)));
dapi(4,3)=(5/(51^2))*(2./length(dfft3))*sum(abs(dfft3(141:191)));
dapi(4,4)=(5/(51^2))*(2./length(dfft4))*sum(abs(dfft4(141:191)));
dapi(4,5)=(5/(51^2))*(2./length(dfft5))*sum(abs(dfft5(141:191)));
dapi(4,6)=(5/(51^2))*(2./length(dfft6))*sum(abs(dfft6(141:191)));
dapi(4,7)=(5/(51^2))*(2./length(dfft7))*sum(abs(dfft7(141:191)));
dapi(4,8)=(5/(51^2))*(2./length(dfft8))*sum(abs(dfft8(141:191)));
dapi(4,9)=(5/(51^2))*(2./length(dfft9))*sum(abs(dfft9(141:191)));
dapi(4,10)=(5/(51^2))*(2./length(dfft10))*sum(abs(dfft10(141:191)));
dapi(4,11)=(5/(51^2))*(2./length(dfft11))*sum(abs(dfft11(141:191)));

save casea aapi -ascii -tabs
save caseb bapi -ascii -tabs
save casec capi -ascii -tabs
save cased dapi -ascii -tabs
```