

get vaccum TF only shot

```
% z t r
date = 230116;
shot_num = 17;
low_n_folder = strcat('C:\Users\uswk0\OneDrive\ドキュメント\GitHub\test-open\道家\卒論\data\' , num2str(shot_num));

raw_signal = read_datafile(shot_num, low_n_folder);
```

```
calib_coefficient = zeros(1,24);
direction = ...
    [1,1,1,1,1,1,...
     -1,1,1,-1,1,1,...
     1,1,1,-1,1,1,...
     1,1,1,1,1,1];
for i = 1:8
    calib_coefficient((i-1)*3+1:(i-1)*3+3) = [37.7,41.6,133]*10^-6;
end
```

```
% rearrange to 1-24 in channel number according to labels on cable
dBdt_TF_only(:,1:24) = raw_signal(:,2:25)./calib_coefficient.*direction;

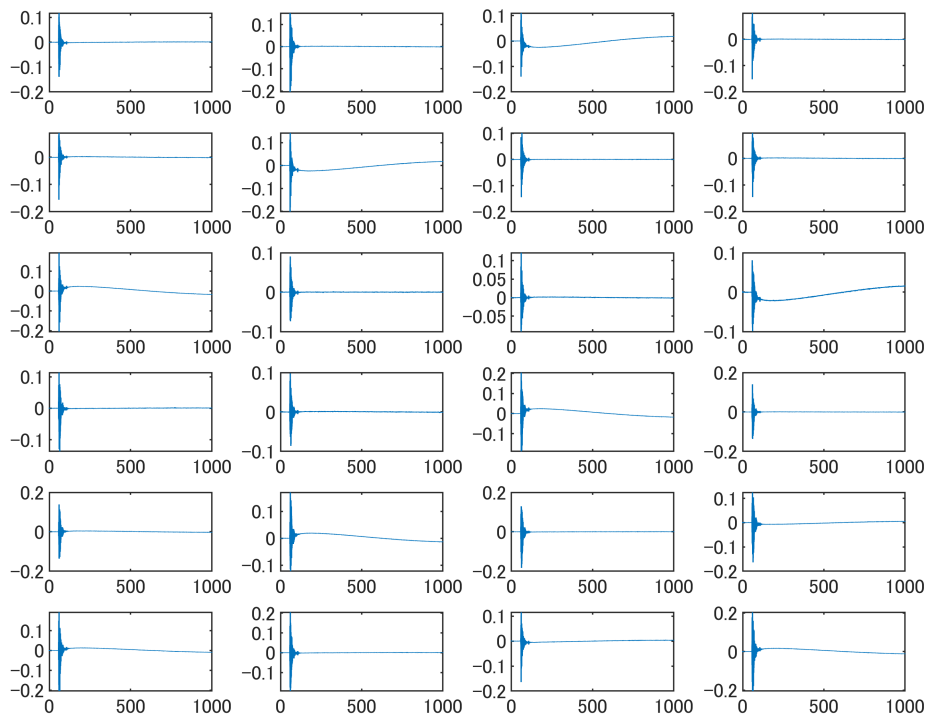
%toroidal_mode_B = toroidal_mode_raw(:,2:25)*1000;
time_array = raw_signal(:,1);

%ここで変数クリアしているので注意
clearvars -except dBdt_TF_only time_array date shot_num t_start t_end...
    y_upperlim y_lowerlim calib_coefficient B_TF_only low_n_folder raw_signal
```

```
% plotting setting
t_start = 0;
t_end = 1000;

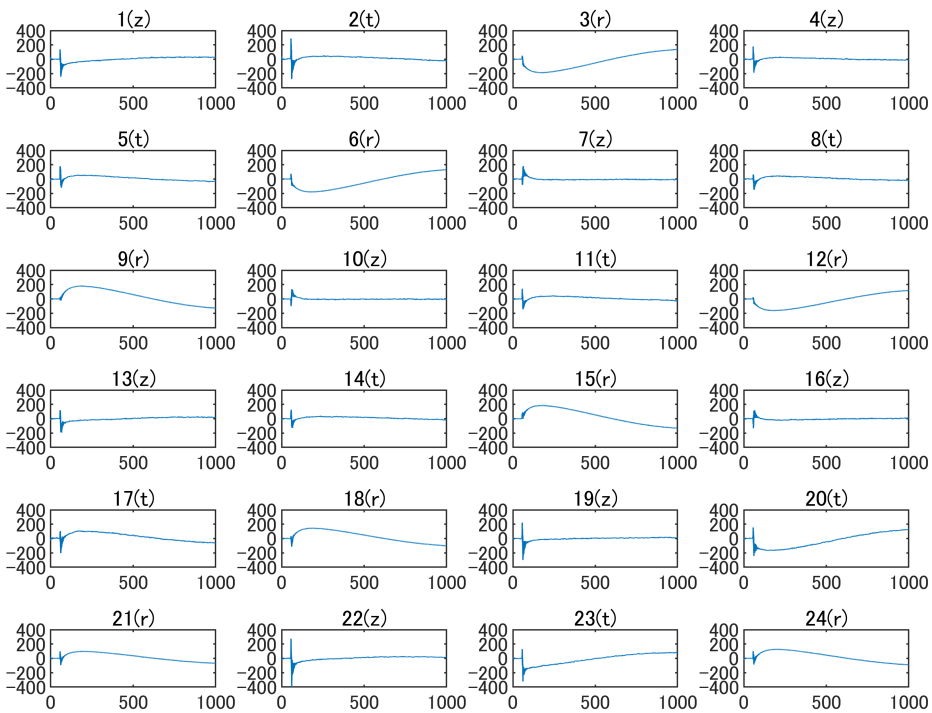
y_upperlim = 400;
y_lowerlim = -400;
```

```
% check all V signals
for i = 1:24
    subplot(6,4,i)
    plot(time_array, raw_signal(:,i+1));
end
```



```
% dB/dt signal plot
```

```
plot_all_ch(time_array,dBdt_TF_only,t_start, t_end,y_lowerlim, y_upperlim,0.004);
```



Bt による較正を試す

% $\text{abs}(\text{dBt}/\text{dt})$ がTF only shotで同じかどうか調べてみる

figure

for i = 1:8

 subplot(2,4,i)

 index_bz = i*3-2;

 index_bt = i*3-1;

 index_br = i*3;

 bt_abs = sqrt(dBdt_TF_only(:,index_bt).^2+dBdt_TF_only(:,index_br).^2);

 hold on

 plot(time_array,smooth(bt_abs));

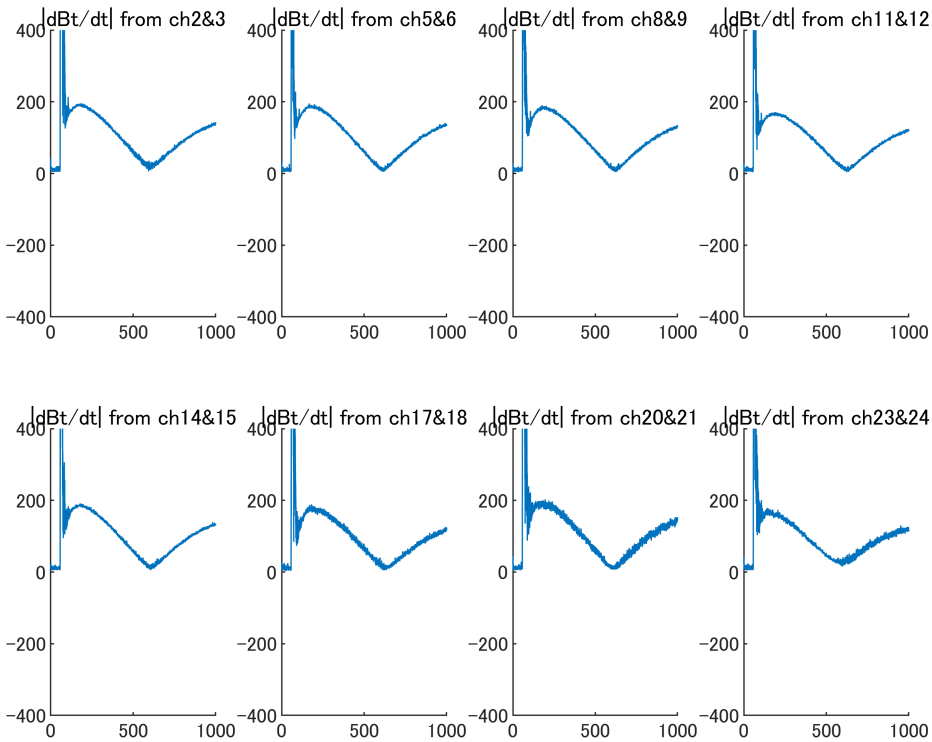
 hold off

 xlim([t_start t_end])

 ylim([y_lowerlim y_upperlim])

 title(['|dBt/dt| from ch',num2str(index_bt),'&',num2str(index_br)])

end



```

x = [0,4/24,7/24,9/24,12/24,15/24,17/24,20/24]; % non-uniform probe placement
%t = time_array(3500:6000);
t = time_array;

bt_abs = zeros(length(time_array), 8);
for i = 1:8
    index_bz = i*3-2;
    index_bt = i*3-1;
    index_br = i*3;
    bt_abs(:,i) = sqrt(dBdt_TF_only(:,index_bt).^2+dBdt_TF_only(:,index_br).^2);
end

%measured_dBzdt = measured_dBzdt(3500:6000,:);
[n_Amp,n_Ph] = toroidal_mode(t,x,bt_abs); % get amplitude and phase
% calculate frequency from phase (smoothed)
n1_Omega = calculate_omega(smooth(cumulative_phase(n_Ph(1,:)),0.1,'loess'));
n2_Omega = calculate_omega(smooth(cumulative_phase(n_Ph(2,:)),0.1,'loess'));
n3_Omega = calculate_omega(smooth(cumulative_phase(n_Ph(3,:)),0.1,'loess'));
% ***** plotting *****
figure('Position', [0 0 800 800]);
subplot(4,4,1:4)
hold on
plot(t,smooth(n_Amp(2,:)./n_Amp(1,:),0.1,'loess'),'k');

```

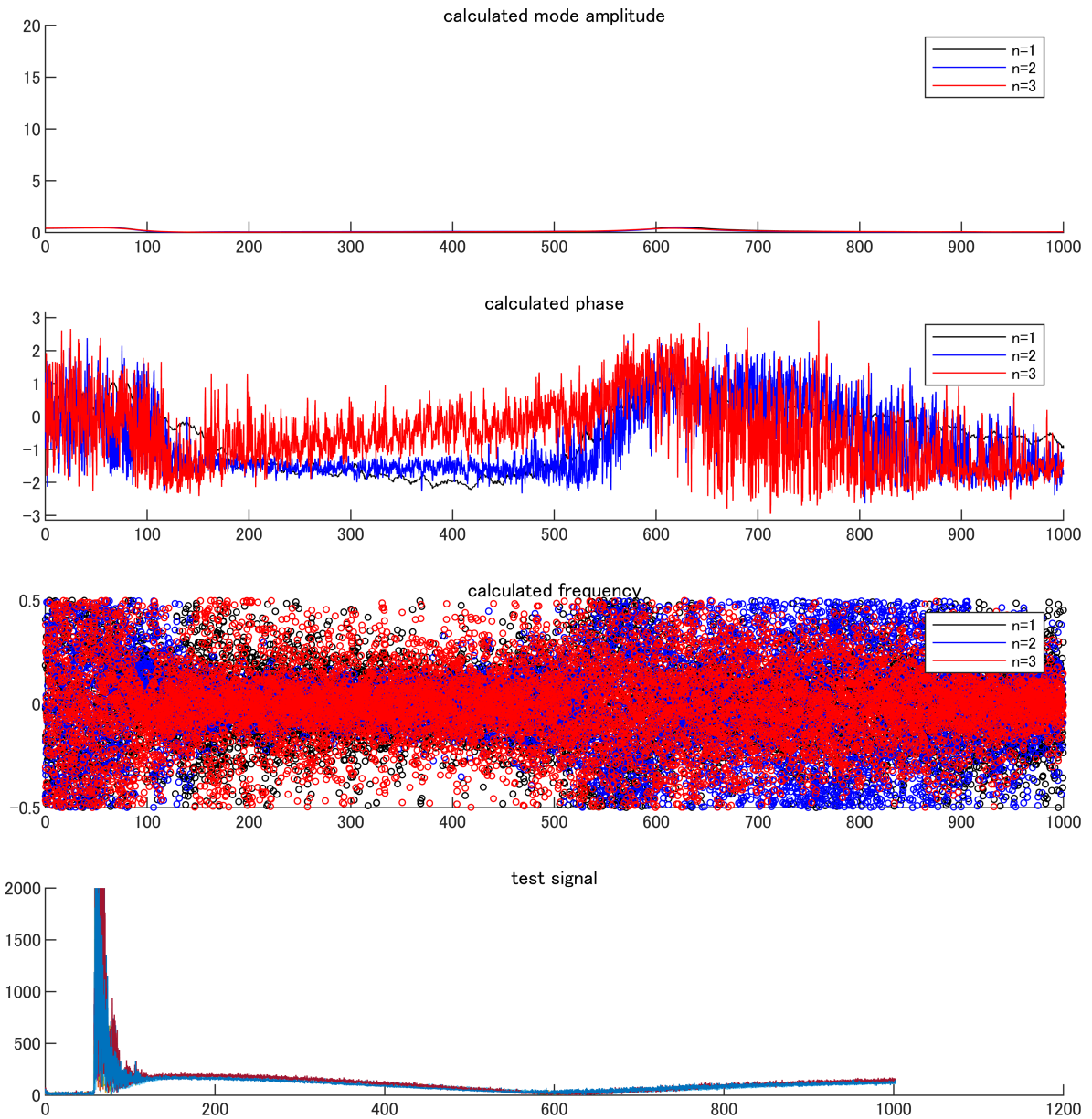
```

plot(t,smooth(n_Amp(3,:)./n_Amp(1,:),0.1,'loess'),'b');
plot(t,smooth(n_Amp(4,:)./n_Amp(1,:),0.1,'loess'),'r');
%scatter(t,n_Amp(2,:)./n_Amp(1,:),6,'k');
%scatter(t,n_Amp(3,:)./n_Amp(1,:),6,'b');
%scatter(t,n_Amp(4,:)./n_Amp(1,:),6,'r');

%scatter(t,smooth(n_Amp(2,:)./n_Amp(1,:)),6,'k');
%scatter(t,smooth(n_Amp(3,:)./n_Amp(1,:)),6,'b');
%scatter(t,smooth(n_Amp(4,:)./n_Amp(1,:)),6,'r');
legend('n=1','n=2','n=3');
ylim([0 20]);
xlim([t_start t_end])
title('calculated mode amplitude')
hold off
subplot(4,4,5:8)
hold on
%plot(t,n_Ph(1,:),'k');plot(t,n_Ph(2,:),'b');plot(t,n_Ph(3,:),'r');
plot(t,smooth(n_Ph(1,:),0.01),'k');plot(t,smooth(n_Ph(2,:)),'b');plot(t,smooth(n_Ph(3,:)),'r');
ylim([-pi pi]);
xlim([t_start t_end])
legend('n=1','n=2','n=3');
title('calculated phase')
hold off
subplot(4,4,9:12)
hold on
plot(t,n1_Omega/(2*pi),'k');
plot(t,n2_Omega/(2*pi),'b');
plot(t,n3_Omega/(2*pi),'r');
scatter(t,calculate_omega(cumulative_phase(n_Ph(1,:)))/(2*pi),6,'k');
scatter(t,calculate_omega(cumulative_phase(n_Ph(2,:)))/(2*pi),6,'b');
scatter(t,calculate_omega(cumulative_phase(n_Ph(3,:)))/(2*pi),6,'r');
legend('n=1','n=2','n=3');
%ylim([-0.1 0.3]);
xlim([t_start t_end])
title('calculated frequency')
hold off
subplot(4,4,13:16)
hold on
for i = 1:8
    plot(t,bt_abs(:,i));
    title('test signal')
end
%積分信号のプロット

%xlim([t_start t_end])
%ylim([y_lowerlim y_upperlim])
ylim([0 2000])
hold off

```



```
clearvars n_Amp n_Ph n1_Omega n2_Omega n3_Omega
```

Bz による較正を試す

```
% Bz が  $\phi$  だけ z 軸から傾いている場合, TF 真空放電
% (Bz) toroidal_mode_B(:,i*3-1) = real_Bt*sin(phi)

% Bt_vacuum ~= Bt_plasma

% vaccum_TF_only の Bz を保存
```

```

measured_dBzdt_TF_only = zeros(length(time_array), 8);
for i = 1:8
    measured_dBzdt_TF_only(:,i) = dBdt_TF_only(:,i*3-1);
end

```

```

%%%%%%%%%%%% Bz_TF_only をノーマルショットから差し引く %%%%%%%%%%%%%%
% z t r
% plasma あり PF 39kV shot の取得
date = 230116;
shot_num = 18;
raw_signal = read_datafile(shot_num,low_n_folder);

```

```

direction = ...
    [1,1,1,1,1,1,...
     -1,1,1,-1,1,1,...
     1,1,1,-1,1,1,...
     1,1,1,1,1,1];
% rearrange to 1-24 in channel number according to labels on cable
dBdt = raw_signal(:,2:25)./calib_coefficient.*direction;

```

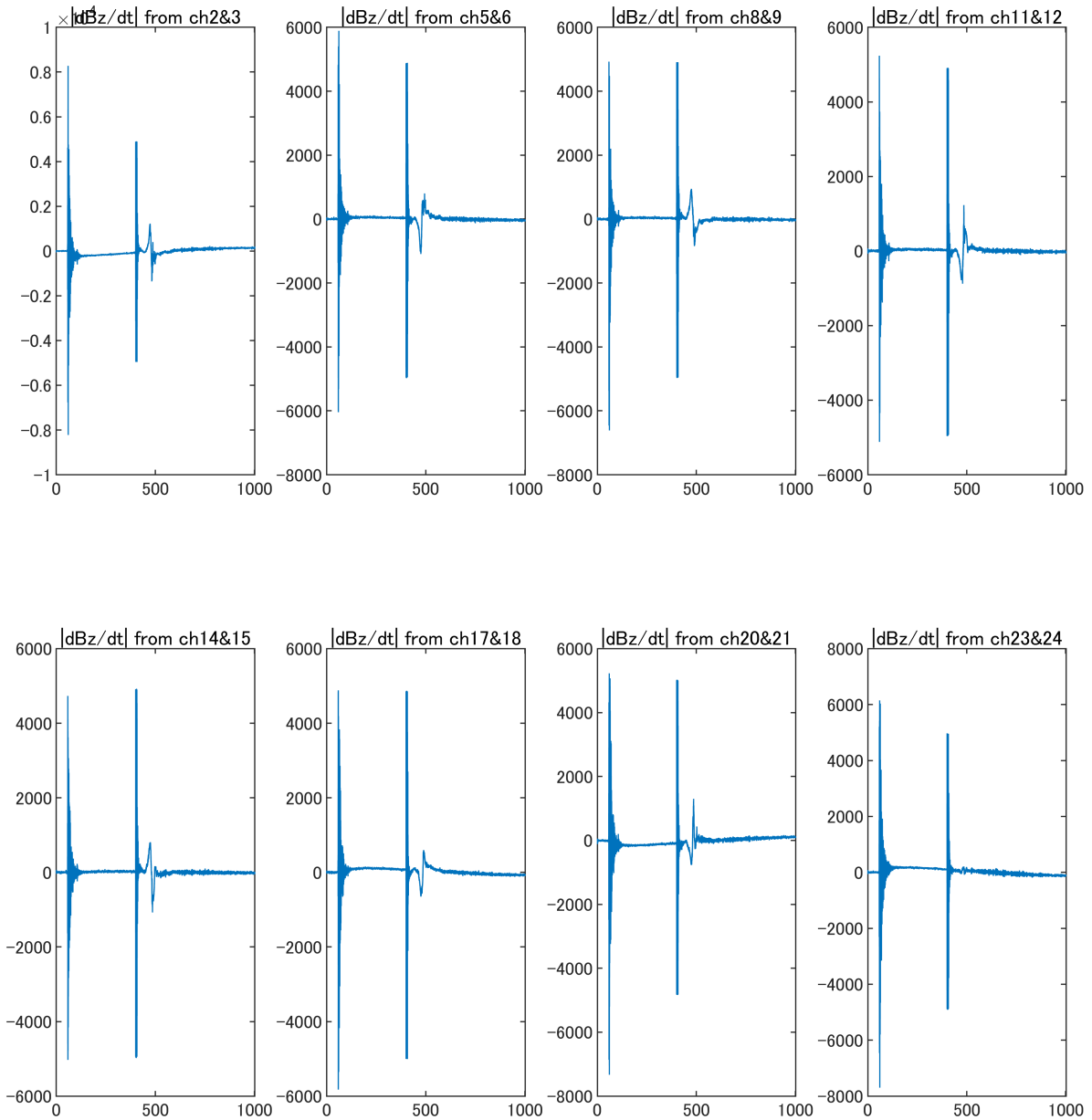
```

%%%%%%%%%%%% Bz を差し引いたものを取得 %%%%%%%%%%%%%%

measured_dBzdt = zeros(length(time_array),8);
for i = 1:8
    measured_dBzdt(:,i) = dBdt(:,i*3-1);
end

for i = 1:8
    measured_dBzdt(:, i) = measured_dBzdt(:, i) - measured_dBzdt_TF_only(:,i);
    subplot(2,4,i)
    plot(time_array, measured_dBzdt(:, i));
    title(['|dBz/dt| from ch',num2str(i*3-1),'& ',num2str(i*3)]);
end

```



```
x = [0,4/24,7/24,9/24,12/24,15/24,17/24,20/24]; % non-uniform probe placement
%t = time_array(3500:6000);
t = time_array;

%measured_dBzdt = measured_dBzdt(3500:6000,:);
[n_Amp,n_Ph] = toroidal_mode(t,x,measured_dBzdt); % get amplitude and phase
% calculate frequency from phase (smoothed)
```



```

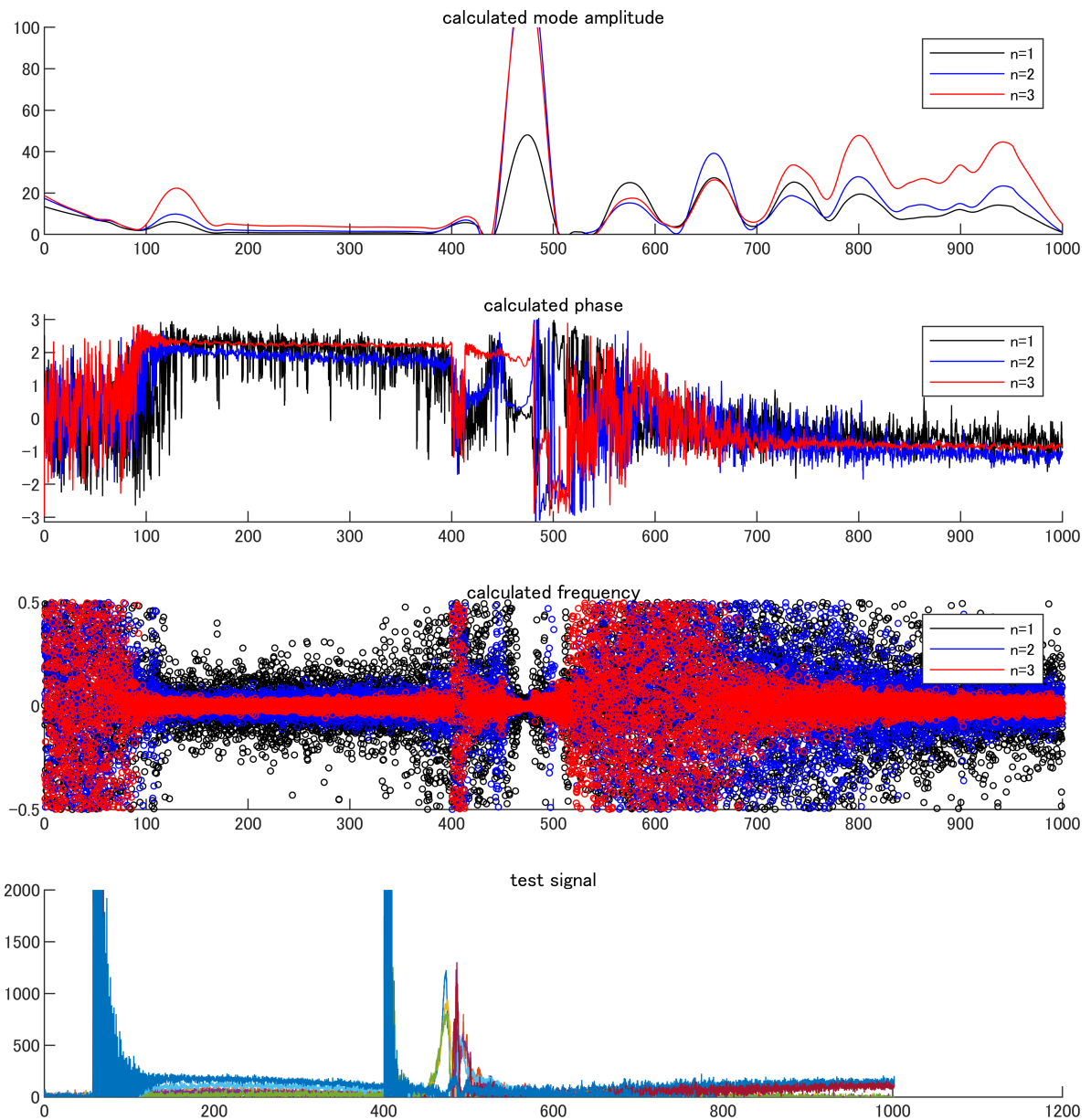
n1_Omega = calculate_omega(smooth(cumulative_phase(n_Ph(1,:)),0.1,'loess'));
n2_Omega = calculate_omega(smooth(cumulative_phase(n_Ph(2,:)),0.1,'loess'));
n3_Omega = calculate_omega(smooth(cumulative_phase(n_Ph(3,:)),0.1,'loess'));
% ***** plotting *****
figure('Position', [0 0 800 800]);
subplot(4,4,1:4)
hold on
plot(t,smooth(n_Amp(2,:)./n_Amp(1,:),0.1,'loess'),'k');
plot(t,smooth(n_Amp(3,:)./n_Amp(1,:),0.1,'loess'),'b');
plot(t,smooth(n_Amp(4,:)./n_Amp(1,:),0.1,'loess'),'r');
%scatter(t,n_Amp(2,:)./n_Amp(1,:),6,'k');
%scatter(t,n_Amp(3,:)./n_Amp(1,:),6,'b');
%scatter(t,n_Amp(4,:)./n_Amp(1,:),6,'r');

%scatter(t,smooth(n_Amp(2,:)./n_Amp(1,:)),6,'k');
%scatter(t,smooth(n_Amp(3,:)./n_Amp(1,:)),6,'b');
%scatter(t,smooth(n_Amp(4,:)./n_Amp(1,:)),6,'r');
legend('n=1','n=2','n=3');
ylim([0 100]);
xlim([t_start t_end])
title('calculated mode amplitude')
hold off
subplot(4,4,5:8)
hold on
%plot(t,n_Ph(1:),'k');plot(t,n_Ph(2:),'b');plot(t,n_Ph(3:),'r');
plot(t,smooth(n_Ph(1:)), 'k');plot(t,smooth(n_Ph(2:)), 'b');plot(t,smooth(n_Ph(3:)), 'r');
ylim([-pi pi]);
xlim([t_start t_end])
legend('n=1','n=2','n=3');
title('calculated phase')
hold off
subplot(4,4,9:12)
hold on
plot(t,n1_Omega/(2*pi),'k');
plot(t,n2_Omega/(2*pi),'b');
plot(t,n3_Omega/(2*pi),'r');
scatter(t,calculate_omega(cumulative_phase(n_Ph(1:)))/(2*pi),6,'k');
scatter(t,calculate_omega(cumulative_phase(n_Ph(2:)))/(2*pi),6,'b');
scatter(t,calculate_omega(cumulative_phase(n_Ph(3:)))/(2*pi),6,'r');
legend('n=1','n=2','n=3');
%ylim([-0.1 0.3]);
xlim([t_start t_end])
title('calculated frequency')
hold off
subplot(4,4,13:16)
hold on
for i = 1:8
    plot(t,measured_dBzdt(:,i));
    title('test signal')
end

```

%積分信号のプロット

```
%xlim([t_start t_end])  
%ylim([y_lowerlim y_upperlim])  
ylim([0 2000])  
hold off
```



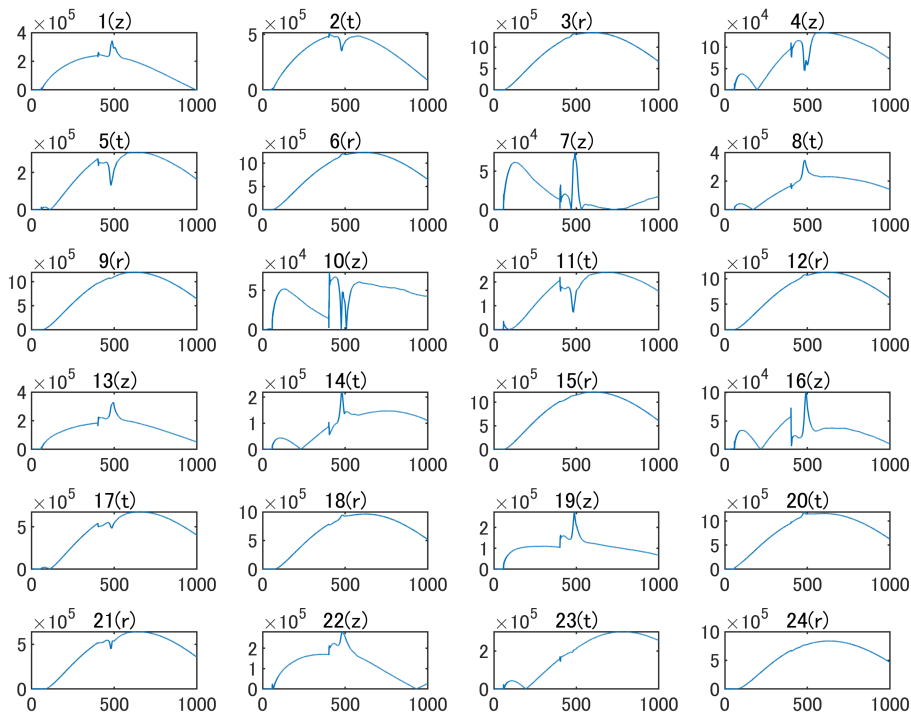
PF 30 kV 各チャンネル積分信号のプロット

figure

```

for i = 1:24
    subplot(6,4,i)
    plot(time_array,abs(cumtrapz(dBdt(:,i))*10^-7*1000*10*1000));
    %xlim([t_start t_end])
    %ylim([-1 1])
    component_all = ['r','z','t'];
    component = component_all(mod(i,3)+1);
    title([num2str(i),'(',component,')'])
end

```



Bp のプローブごとの比較

```

figure
for i = 1:8
    subplot(2,4,i)
    index_bz = i*3-2;
    index_bt = i*3-1;
    index_br = i*3;
    bp_abs = sqrt(dBdt(:,index_bz).^2 + dBdt(:,index_br).^2 + dBdt(:,index_bt).^2);
    plot(time_array,bp_abs);
    xlim([t_start t_end])
    %ylim([y_lowerlim y_upperlim])
    ylim([0 500])
    title(['|dBp/dt| from ch',num2str(index_bz),'-',num2str(index_br)])
end

```

