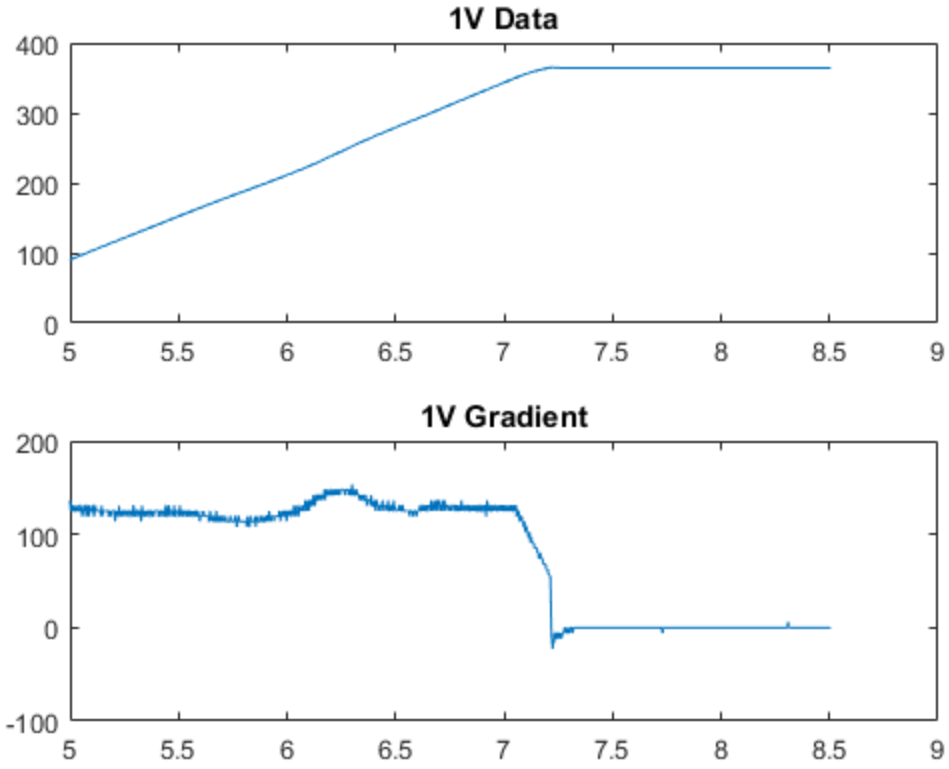
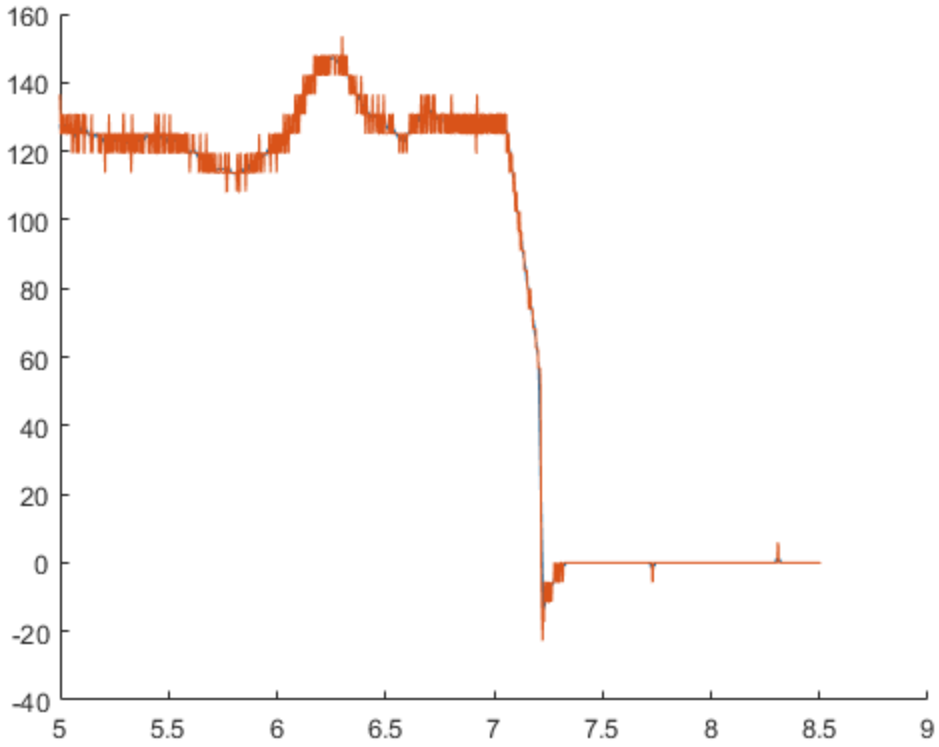
```
clc; close all; clear;
%------------------------------------------------------------------------
%First Experiment 1 V Cart Data
%------------------------------------------------------------------------
load('1VCartData')
step = time(2) - time(1);%Universal Step Size
cartP1V = cartPosition;
gradP1V = gradient(cartP1V,step);
time1V = time;
figure()
subplot(2,1,1);
plot(time1V, cartP1V);
title('1V Data');
subplot(2,1,2);
plot(time1V, gradP1V);
title('1V Gradient');
%Flat Line Detection
filterGrad1V = movingAverage(gradP1V,11);
figure()
hold on;
plot(time1V, filterGrad1V, time1V, gradP1V);
[slopeVect1V, ~] = slopeDetermination(filterGrad1V,time1V, step);
slopeCoeff1V = mean(slopeVect1V);
fprintf('Cart 1V Slope Coefficient | %g\n', slopeCoeff1V);
%------------------------------------------------------------------------
%Second Experiment 3 V Cart Data
%------------------------------------------------------------------------
load('3VCartData')
cartP3V = cartPosition;
gradP3V = gradient(cartP3V,step);
time3V = time;
figure()
subplot(2,1,1);
plot(time3V, cartP3V);
title('3V Data');
subplot(2,1,2);
plot(time3V, gradient(cartP3V,step));
title('3V Gradient');
%Flat Line Detection
filterGrad3V = movingAverage(gradP3V,11);
figure()
hold on;
plot(time3V, filterGrad3V, time3V, gradP3V);
[slopeVect3V, ~] = slopeDetermination(filterGrad3V,time3V, step);
slopeCoeff3V = mean(slopeVect3V);
fprintf('Cart 3V Slope Coefficient | %g\n', slopeCoeff3V);
%------------------------------------------------------------------------
%Third Experiment 3 V Cart Data (with Mass)
%------------------------------------------------------------------------
load('3VMCartData')
cartP3VM = cartPosition;
gradP3VM = gradient(cartP3VM,step);
```

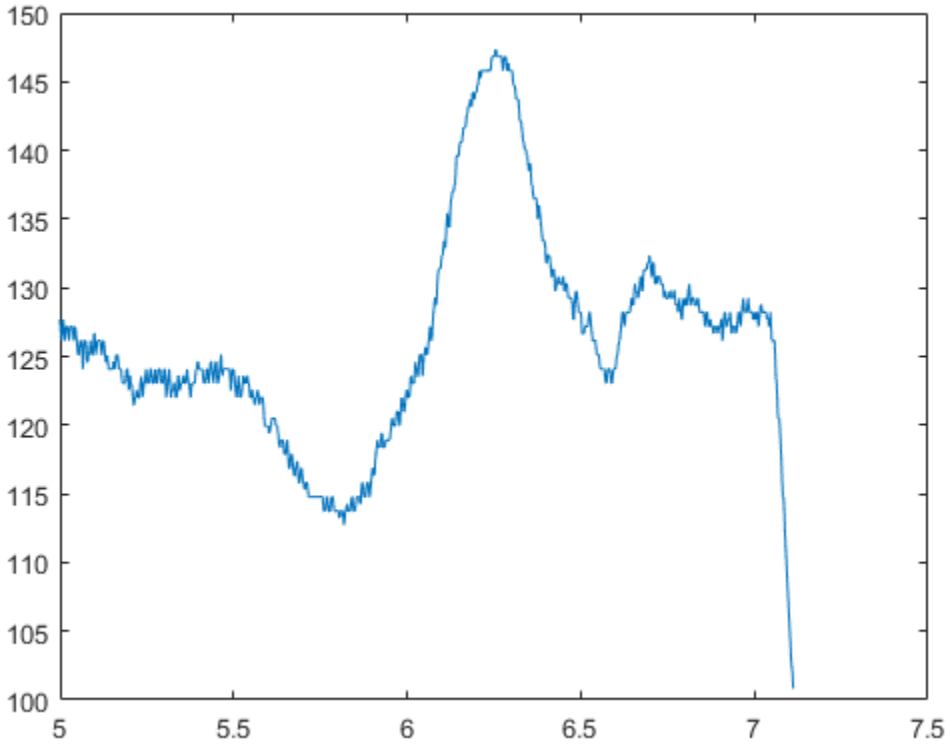
```
time3VM = time;
figure()
subplot(2,1,1);
plot(time3VM, cartP3VM);
title('3V Data (With Mass)');
subplot(2,1,2);
plot(time3VM, gradient(cartP3VM,step));
title('3V Gradient');
%Flat Line Detection
filterGrad3VM = movingAverage(gradP3VM,11);
figure()
hold on;
plot(time3VM, filterGrad3VM, time3VM, gradP3VM);
[slopeVect3VM, ~] = slopeDetermination(filterGrad3VM,time3VM, step);
slopeCoeff3VM = mean(slopeVect3VM);
fprintf('Cart 3VM Slope Coefficient | %g\n', slopeCoeff3VM);
%------------------------------------------------------------------------
%Fourth Experiment 5 V Cart Data
%------------------------------------------------------------------------
load('5VCartData')
cartP5V = cartPosition;
gradP5V = gradient(cartP5V,step);
time5V = time;
figure()
subplot(2,1,1);
plot(time5V, cartP5V);
title('5V Data');
subplot(2,1,2);
plot(time5V, gradient(cartP5V,step));
title('5V Gradient');
%Flat Line Detection
filterGrad5V = movingAverage(gradP5V,11);
figure()
hold on;
plot(time5V, filterGrad5V, time5V, gradP5V);
[slopeVect5V, ~] = slopeDetermination(filterGrad5V,time5V, step);
slopeCoeff5V = mean(slopeVect5V);
fprintf('Cart 5V Slope Coefficient | %g\n', slopeCoeff5V);
%------------------------------------------------------------------------
%Fifth Experiment 0V Tilt Data
%------------------------------------------------------------------------
load('0VTiltData')
cartT0V = cartPosition;
gradT0V = gradient(cartT0V,step);
timeT0V = time;
figure()
subplot(2,1,1);
plot(timeT0V, cartT0V);
title('0V Tilt Data');
subplot(2,1,2);
plot(timeT0V, gradient(cartT0V,step));
title('0V Tilt Gradient');
clear('time', 'cartPosition')
%Flat Line Detection
```

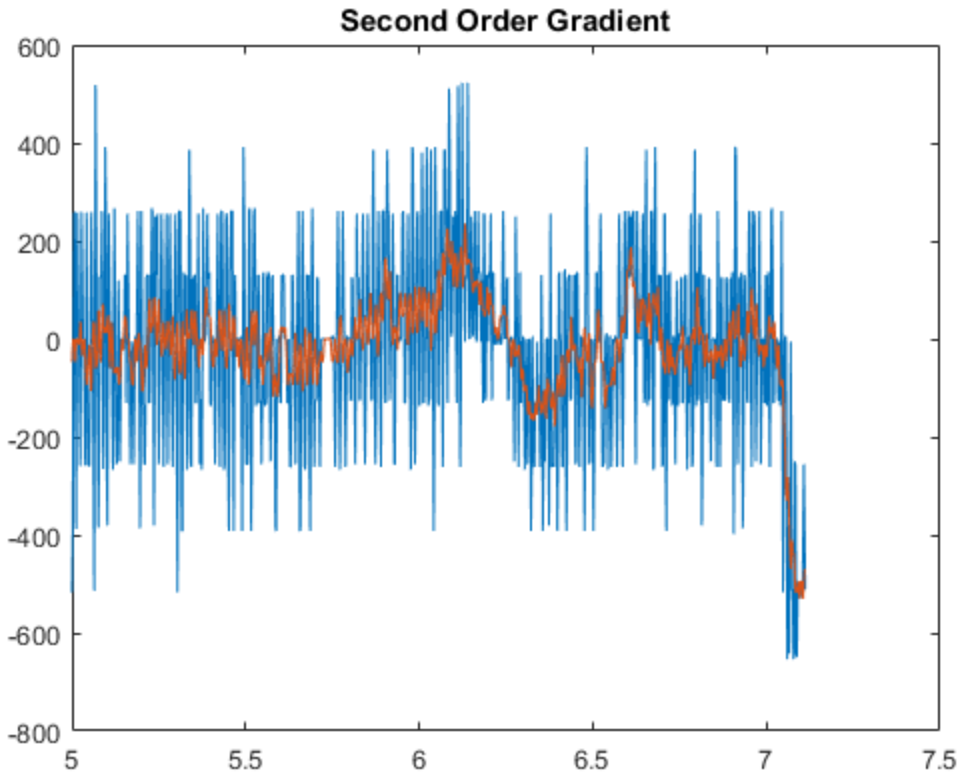
```
filterGradT0V = movingAverage(gradT0V,11);
figure()
hold on;
plot(timeT0V, filterGradT0V, timeT0V, gradT0V);
[slopeVectT0V, ~] = slopeDetermination(filterGradT0V,timeT0V, step);
slopeCoeffT0V = mean(slopeVectT0V);
fprintf('Cart T0V Slope Coefficient | %g\n', slopeCoeffT0V);
```

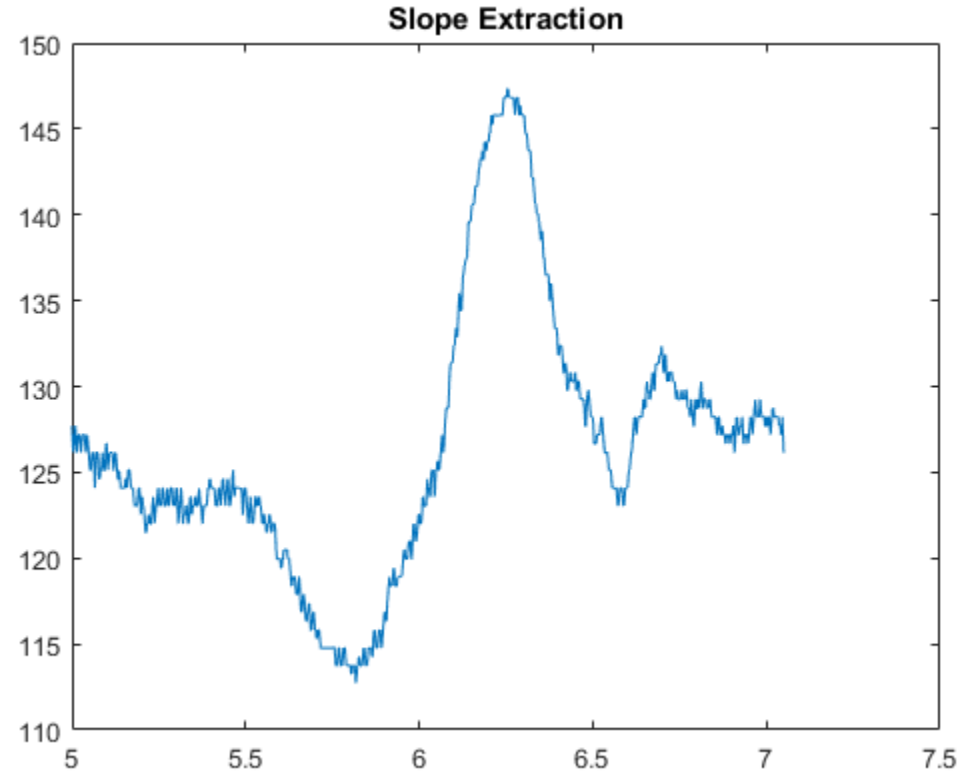
```
Cart 1V Slope Coefficient | 126.529
Cart 3V Slope Coefficient | 485.834
Cart 3VM Slope Coefficient | 479.704
Cart 5V Slope Coefficient | 844.122
Cart T0V Slope Coefficient | 155.914
```

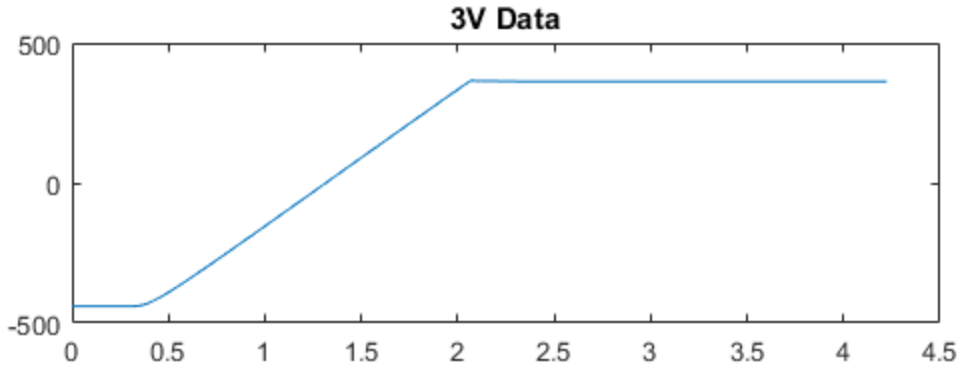


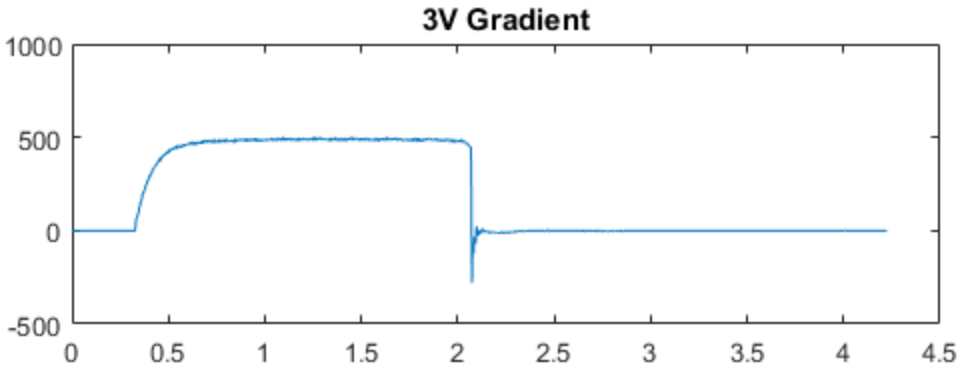

160
140
120
100
80
60
40
20
0
-20
-40
5
5.5
6
6.5
7
7.5
8
8.5
9

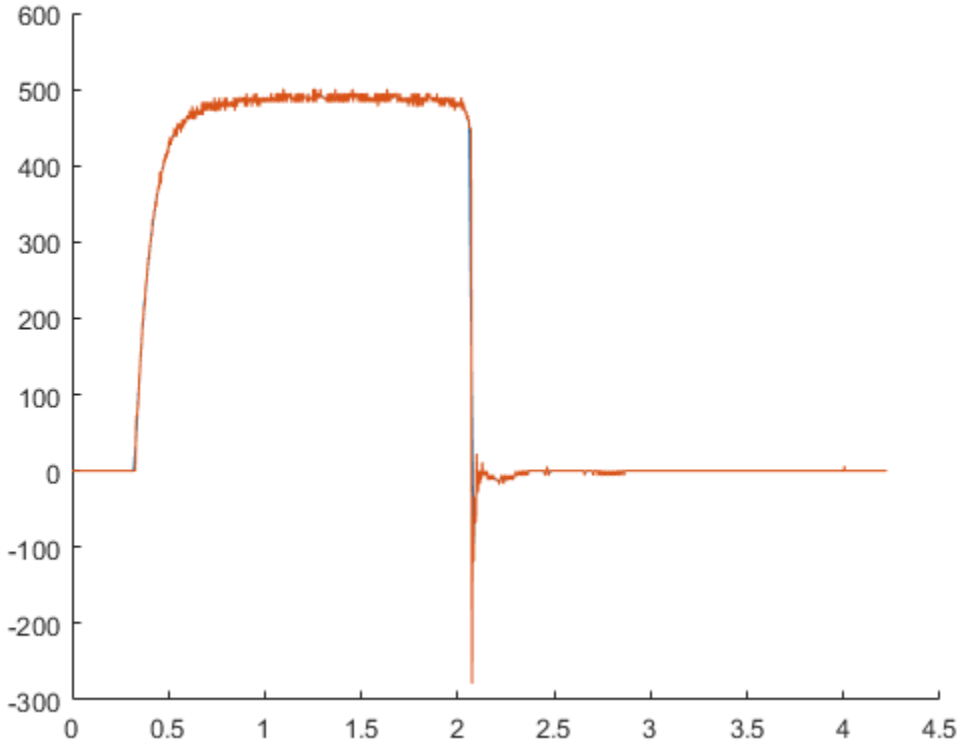

150
145
140
135
130
125
120
115
110
105
100
5
5.5
6
6.5
7
7.5

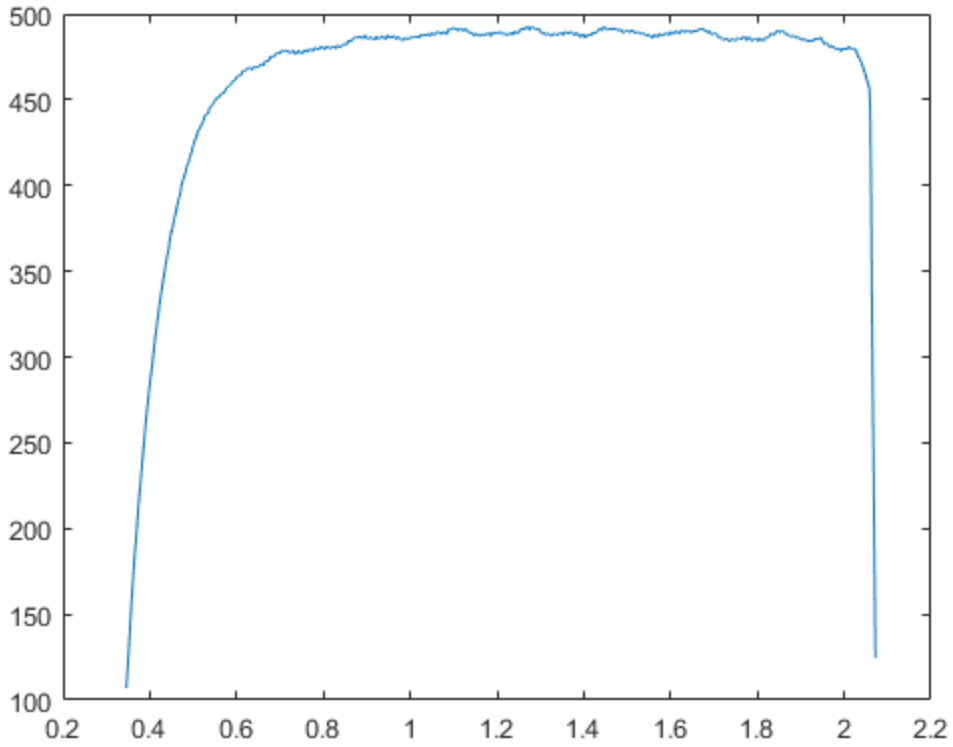

Second Order Gradient
600
400
200
0
-200
-400
-600
-800
5
5.5
6
6.5
7
7.5

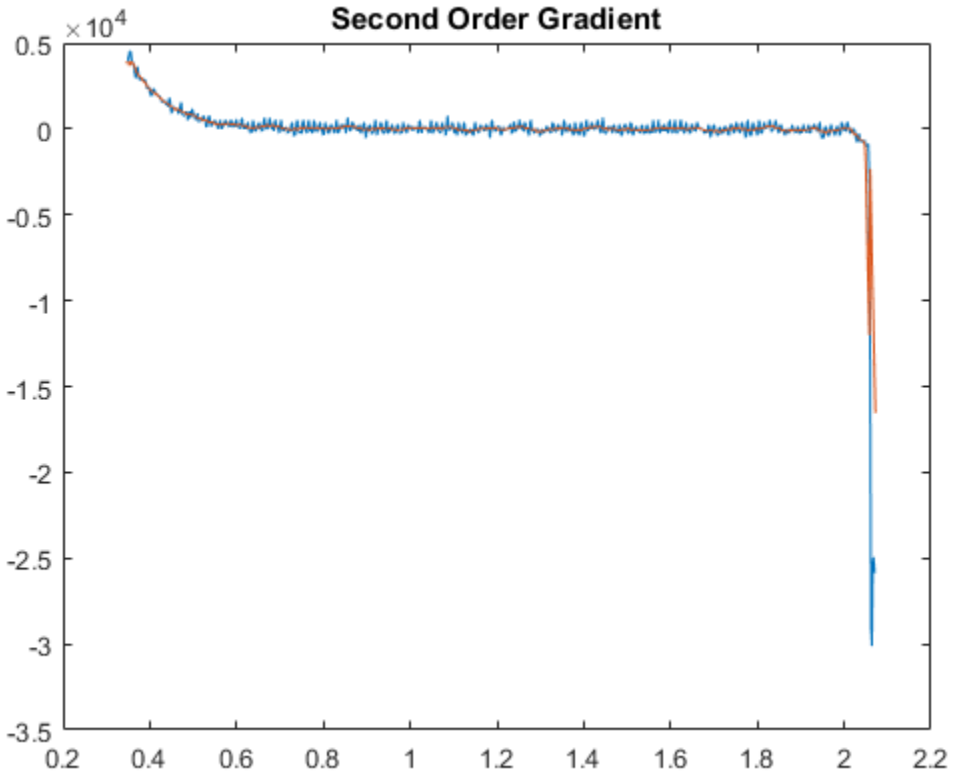

Slope Extraction
150
145
140
135
130
125
120
115
110
5
5.5
6
6.5
7
7.5

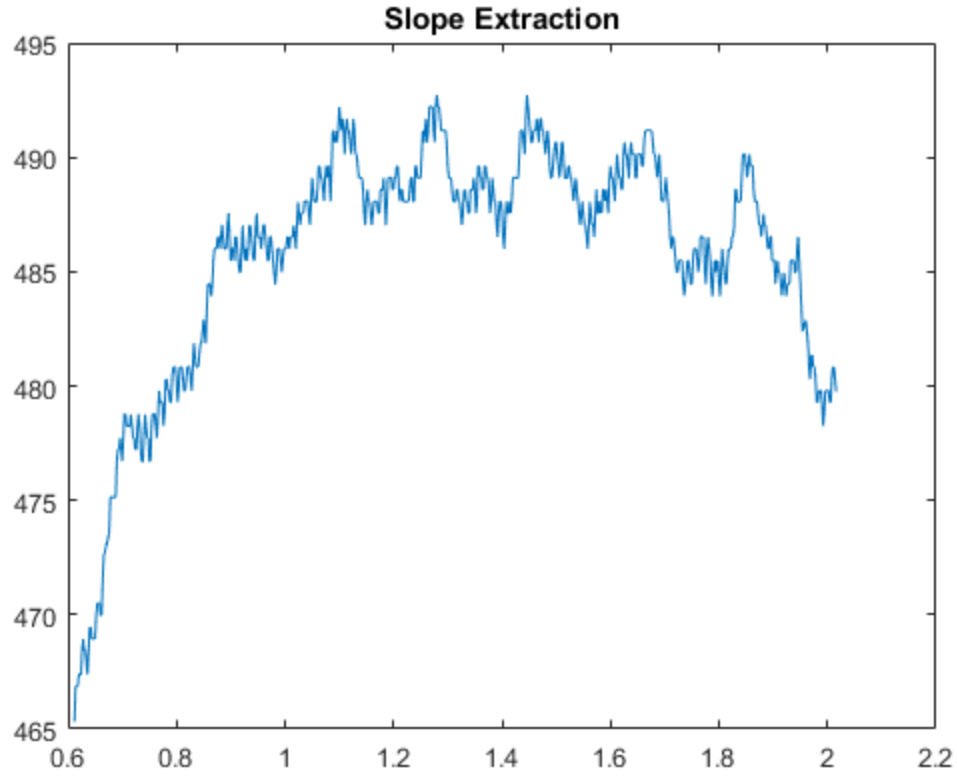

3V Data
500
0
-500
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5

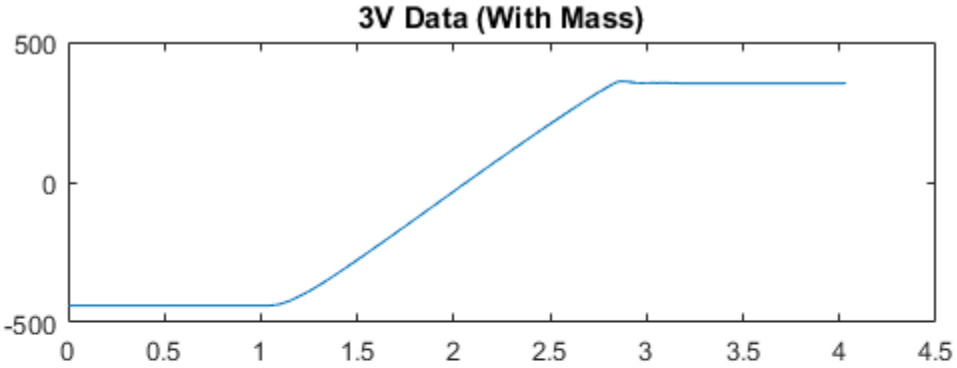

3V Gradient
1000
500
0
-500
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5

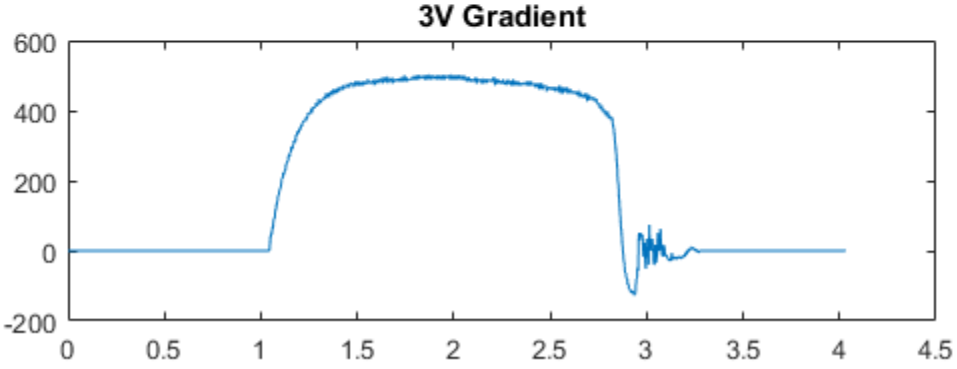

600
500
400
300
200
100
0
-100
-200
-300
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5

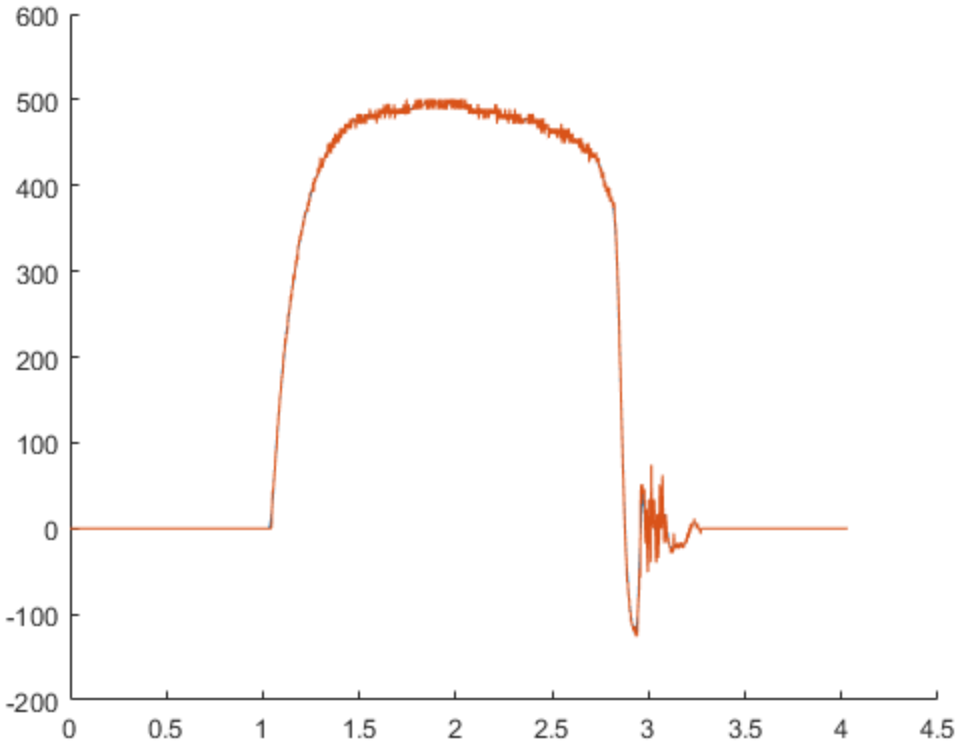

500
450
400
350
300
250
200
150
100
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2

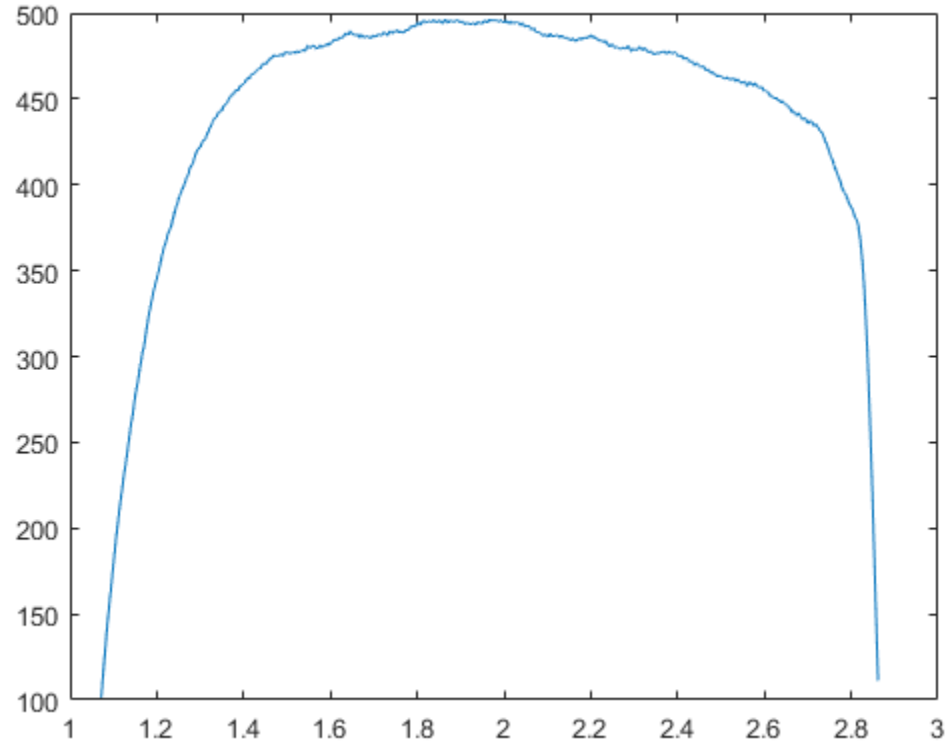

Second Order Gradient
×10^4
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2

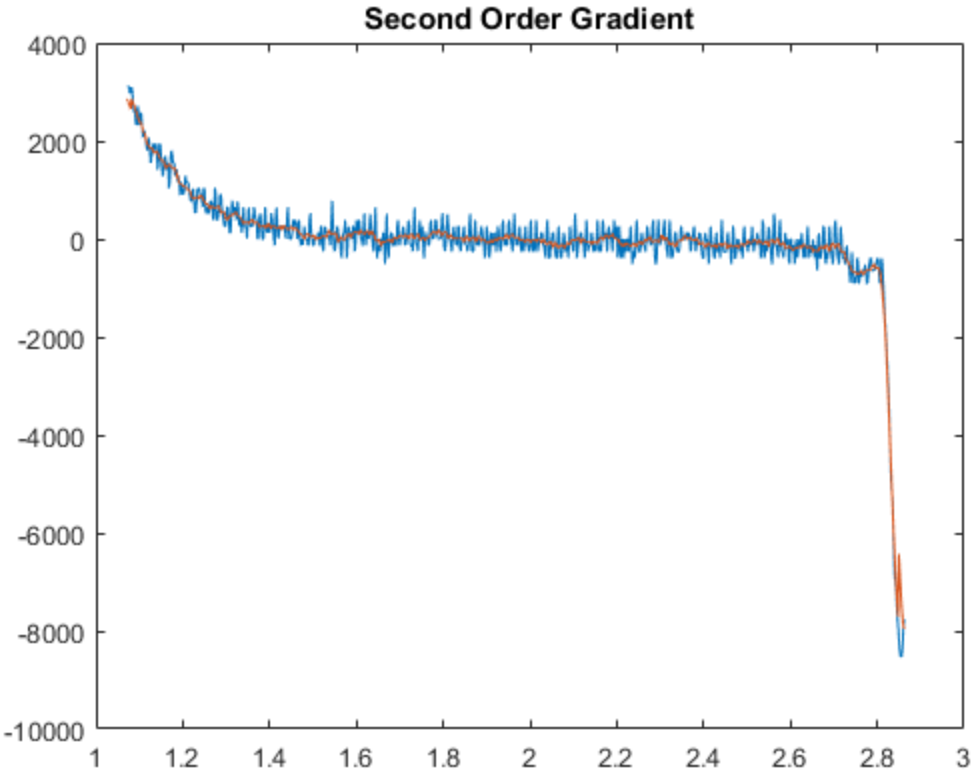

Slope Extraction
495
490
485
480
475
470
465
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2

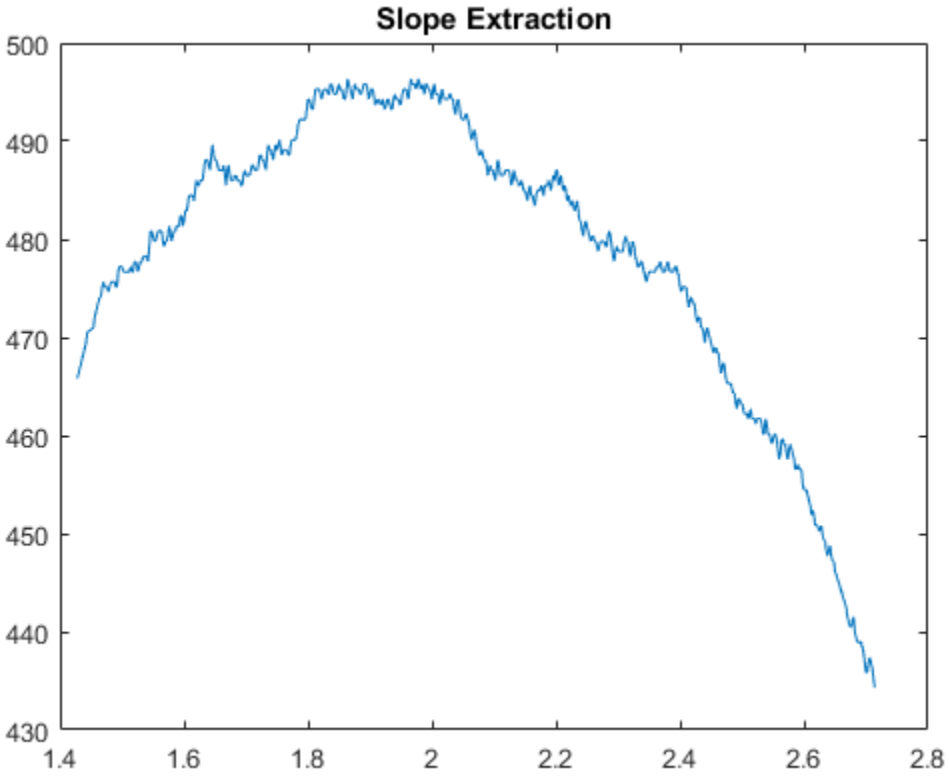

3V Data (With Mass)
500
0
-500
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5

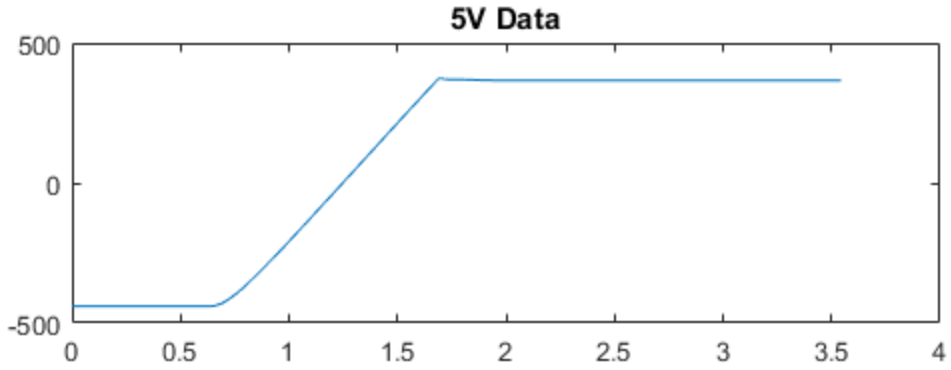

3V Gradient
600
400
200
0
-200
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5

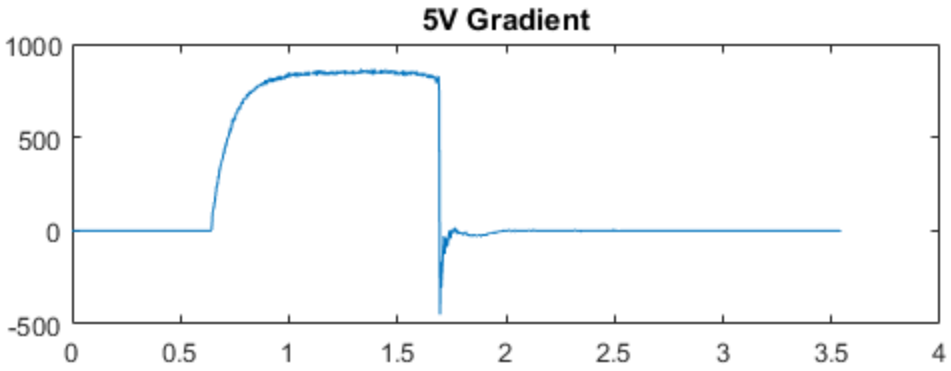

600
500
400
300
200
100
0
-100
-200
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5

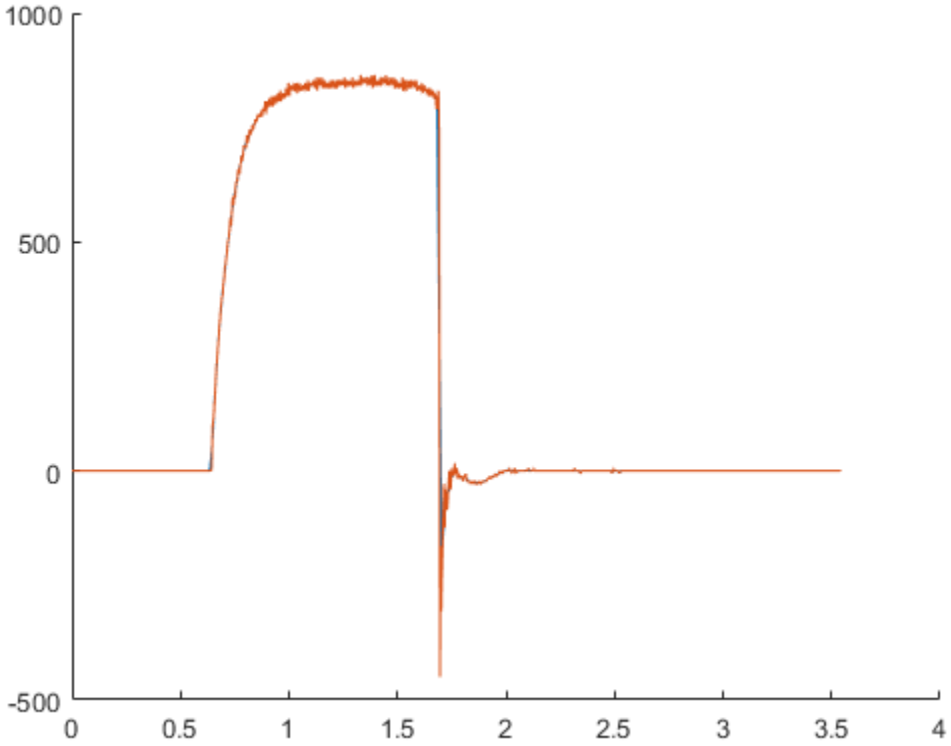

500
450
400
350
300
250
200
150
100
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3

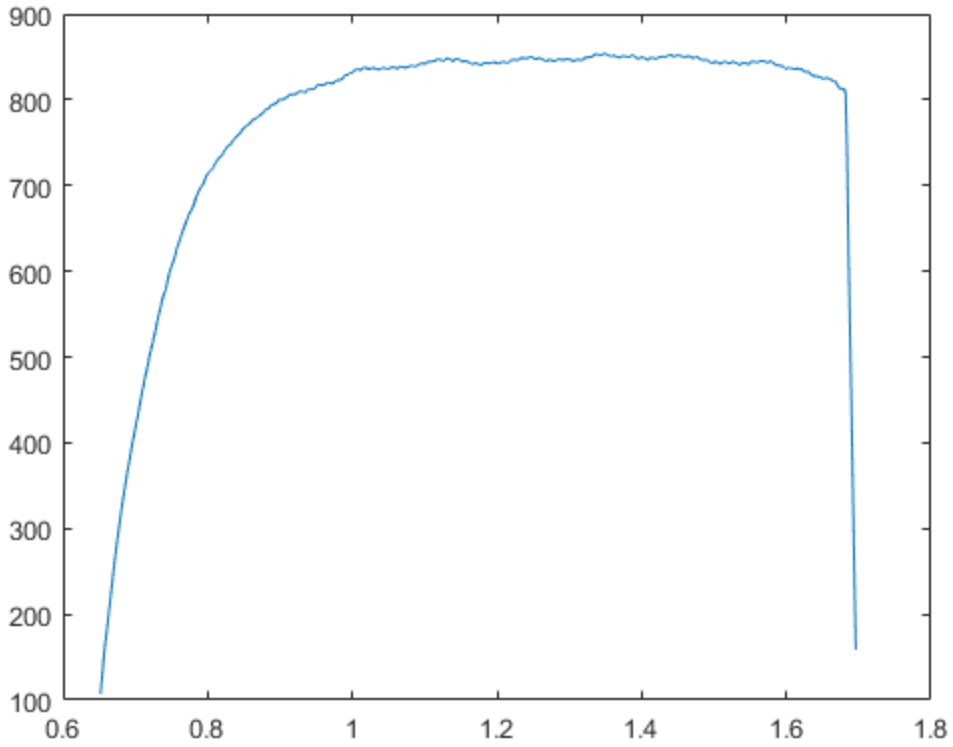

Second Order Gradient
4000
2000
0
-2000
-4000
-6000
-8000
-10000
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3

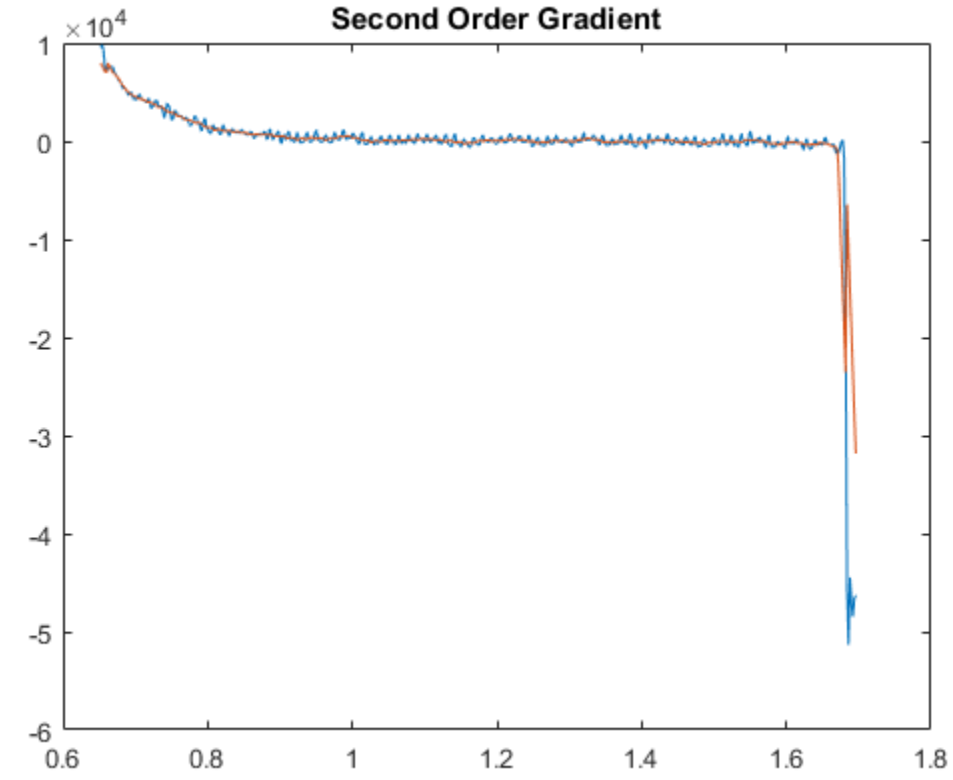

Slope Extraction
500
490
480
470
460
450
440
430
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8

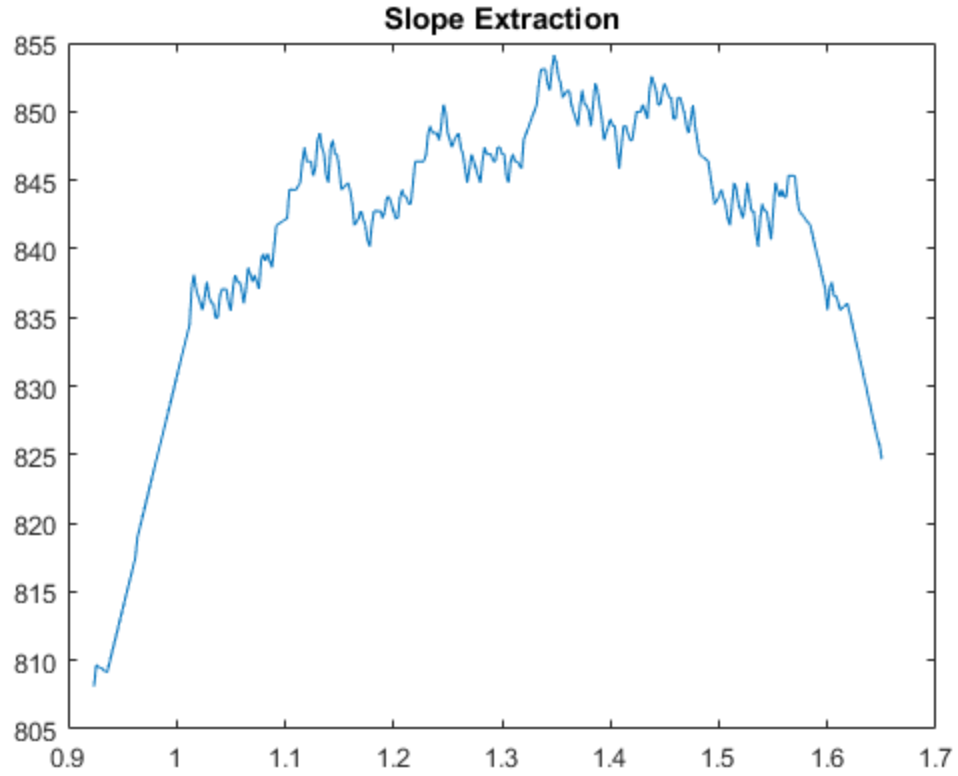

5V Data
500
0
-500
0
0.5
1
1.5
2
2.5
3
3.5
4

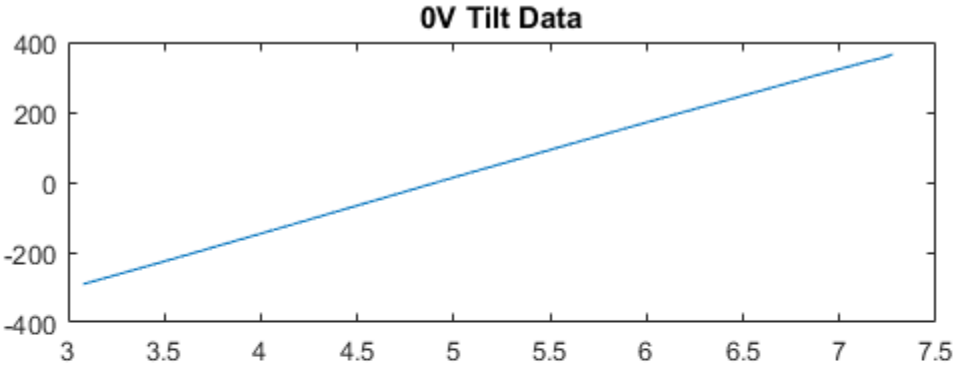

5V Gradient
1000
500
0
-500
0
0.5
1
1.5
2
2.5
3
3.5
4

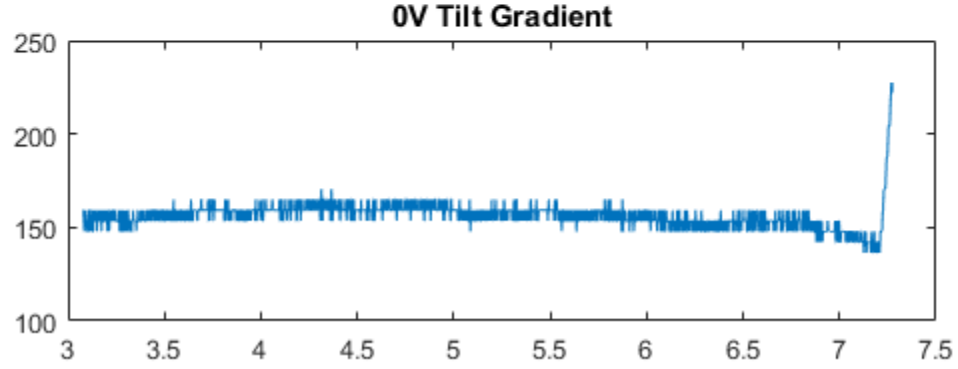

1000
500
0
-500
0
0.5
1
1.5
2
2.5
3
3.5
4

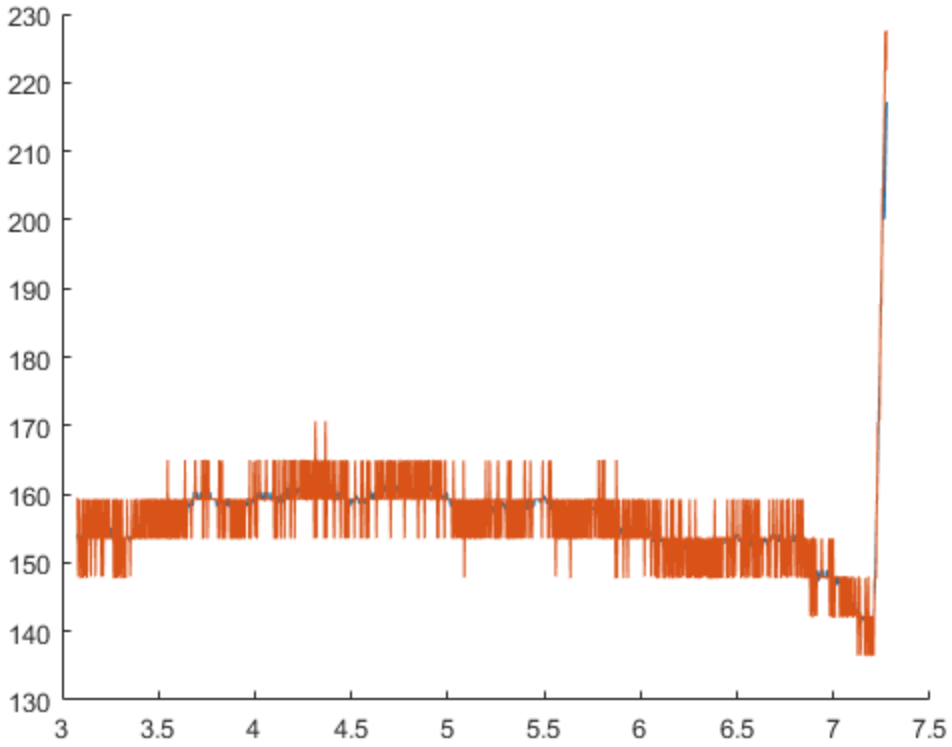

900
800
700
600
500
400
300
200
100
0.6
0.8
1
1.2
1.4
1.6
1.8

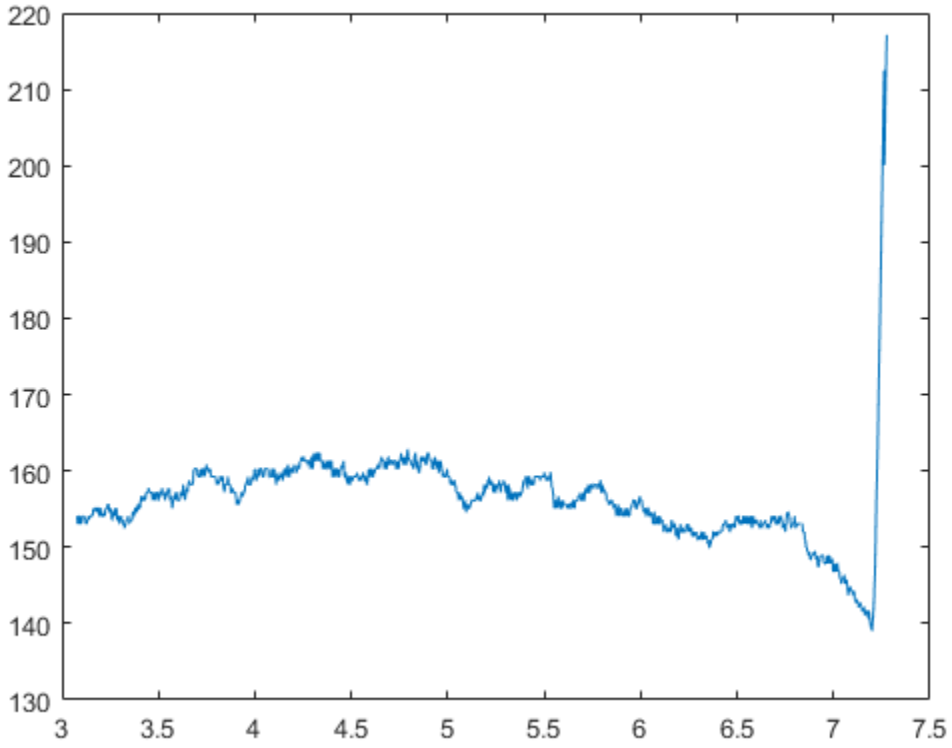

Second Order Gradient
×10^4
1
0
-1
-2
-3
-4
-5
-6
0.6
0.8
1
1.2
1.4
1.6
1.8

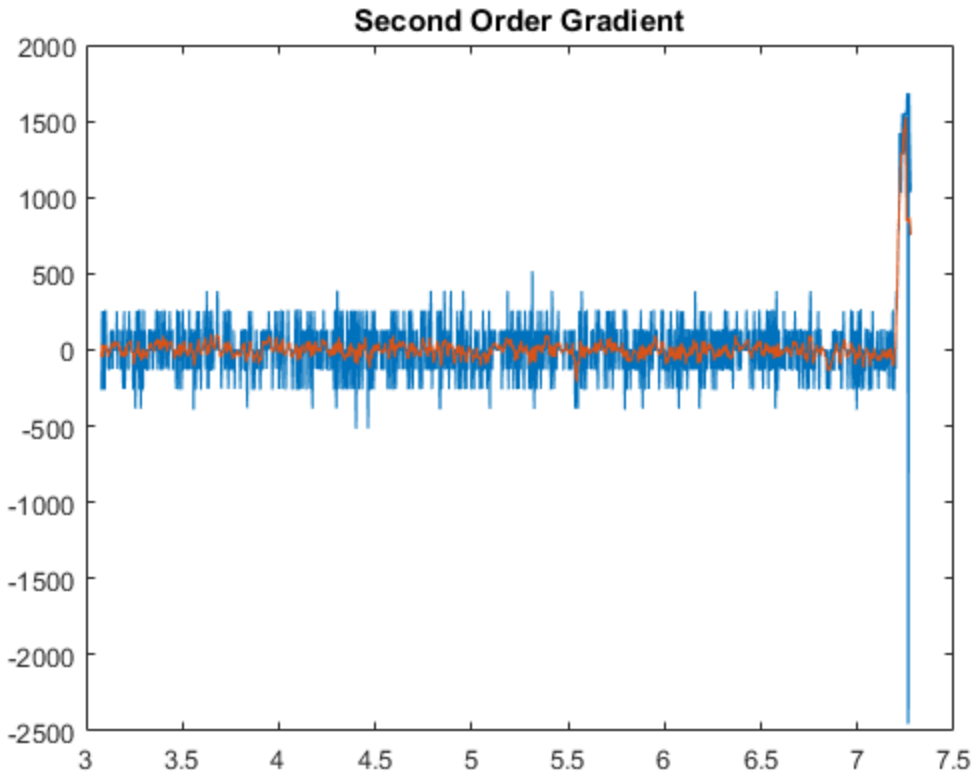

Slope Extraction
855
850
845
840
835
830
825
820
815
810
805
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7

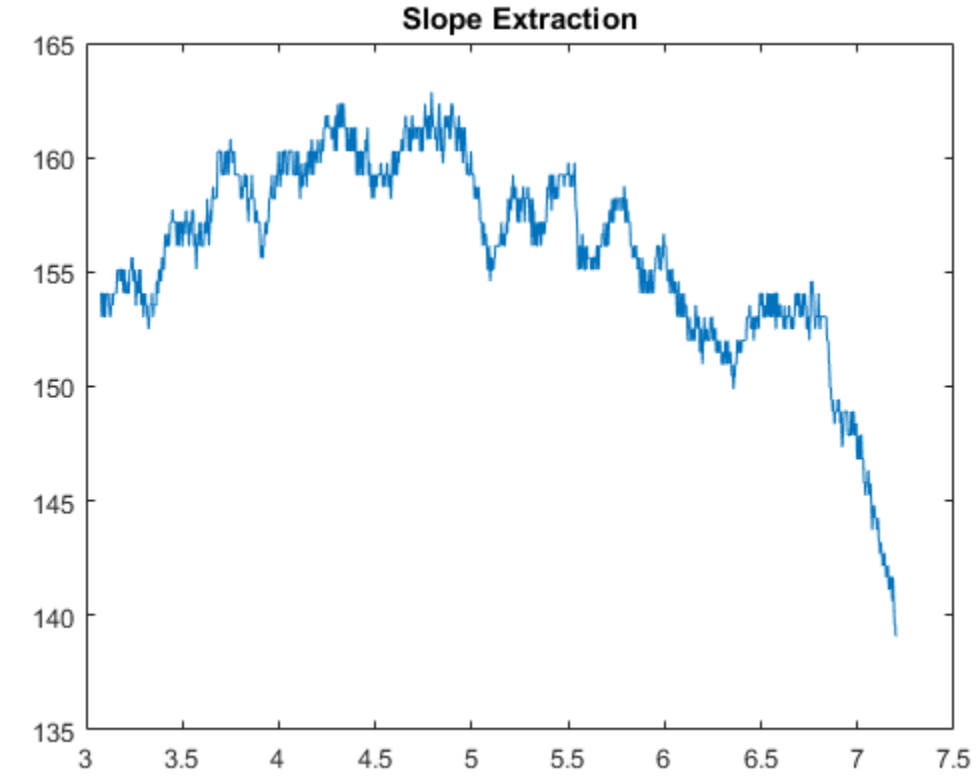

0V Tilt Data
400
200
0
-200
-400
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5


0V Tilt Gradient
250
200
150
100
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5


230
220
210
200
190
180
170
160
150
140
130
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5


220
210
200
190
180
170
160
150
140
130
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5


Second Order Gradient
2000
1500
1000
500
0
-500
-1000
-1500
-2000
-2500
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5


Slope Extraction
165
160
155
150
145
140
135
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5

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