```
% looks like blue dots are 1st msec, red are 2nd
% (:,4) is the 2nd measured msec (inverted to account for the switch it
% polarity
% (:,3) is the 1st measured msec)
% (:,6) is the theory

% get a clean workspace, make sure data is loaded
close all
```

My function to plot this - requires statistics toolbox i believe

```
function [curve1_1st,gof1_1st,curve1_2nd,gof1_2nd] = scatterplot_func(d1)


s = inputname(1);


%scatter with linear fit

figure;plot(d1(:,3),d1(:,6),'bo')

hold on;plot(-d1(:,4),d1(:,6),'ro')

xlim([-.6 .6])

ylim([-.6 .6])

[curve1_1st,gof1_1st] = fit(d1(:,3),d1(:,6),'poly1','Exclude', isnan(d1(:,3)),'Exclude',isnan(d1(:,6)))

[curve1_2nd,gof1_2nd] = fit(-d1(:,4),d1(:,6),'poly1','Exclude', isnan(d1(:,4)),'Exclude',isnan(d1(:,6)))

a = plot(curve1_1st,'b');

a.LineWidth = 2;

b = plot(curve1_2nd,'r');

b.LineWidth = 2;

x = [-0.6 0.6];

y = [-0.6 0.6];

plot(x,y,'k','linewidth',2)

legend({'1st part of pulse','2nd part of pulse','1st part fit','2nd part fit','line of y = x'},'Location','northwest')

xlabel('Measured voltage (V)')

ylabel('Theoretical Voltage (V)')

title({s,' theory vs. experiment'})


% scatterhist
```

```
figure;
exp = [d1(:,3);-d1(:,4)];
theory = [d1(:,6);d1(:,6)];
groups = cell(128,1);
groups(1:64) = {'1st'};
groups(65:end) = {'2nd'};
scatterhist(exp,theory,'Group',groups,'PlotGroup','on','Color','br','LineWidth',[2,2],'kernel','on')
xlabel('Measured voltage (V)')
ylabel('Theoretical Voltage (V)')
title({s,' theory vs. experiment'})


end
```

```
% load in stephen's data
close all;clearvars ; clc
load('Z:\FilesFromLarry\6-9-2016\stephens ss\stephens ss\dd.mat');
```

STATS FUNCTION

```
%% stats function for scatter plots


function [p1,p2,p3,p4,p5,cellStats] = scatterplot_stats(d1)


s = inputname(1);


exp = [d1(:,3);-d1(:,4)];
theory = [d1(:,6);d1(:,6)];
groups = cell(128,1);
groups(1:64) = {'1st'};
groups(65:end) = {'2nd'};


% test if experiment data is normally distributed
fprintf(['Normality test experiment for ',s])
[h1,p1,kstat1,crtival1] = lillietest(exp)
```

```
% test if theory is normally distributed
fprintf(['Normality test theory for ',s])

[h2,p2,kstat2,crtival2] = lillietest(theory)

% signed rank test
fprintf(['Signed rank sum test between experiment and theory for ',s])
[p3,h3,stats3] = signrank(exp,theory)

% rank sum test
fprintf(['rank sum test between experiment and theory ',s])
[p4,h4,stats4] = ranksum(exp,theory)

% KS test
fprintf(['Kolmogorov Smirnov Test between experiment and theory ',s])
[h5,p5] = kstest2(exp,theory)

cellStats = [p1 p2 p3 p4 p5];

end
```

```
% call stats functs
[~,~,~,~,~,d1Stats] =scatterplot_stats(d1);
```

```
Normality test experiment for d1
Warning: P is less than the smallest tabulated value, returning 0.001.

Normality test theory for d1
Warning: P is less than the smallest tabulated value, returning 0.001.

Signed rank sum test between experiment and theory for d1rank sum test between experiment and theory d1K
```

```
[~,~,~,~,~,d2Stats] =scatterplot_stats(d2);
```

```
Normality test experiment for d2
Warning: P is less than the smallest tabulated value, returning 0.001.

Normality test theory for d2
Warning: P is less than the smallest tabulated value, returning 0.001.

Signed rank sum test between experiment and theory for d2rank sum test between experiment and theory d2K
```

```
[~,~,~,~,~,d3Stats] =scatterplot_stats(d3);
```

```
Normality test experiment for d3
Warning: P is less than the smallest tabulated value, returning 0.001.

Normality test theory for d3
Warning: P is less than the smallest tabulated value, returning 0.001.

Signed rank sum test between experiment and theory for d3rank sum test between experiment and theory d3K
```

```
[~,~,~,~,~,d4Stats] =scatterplot_stats(d4);
```

```
Normality test experiment for d4
Warning: P is less than the smallest tabulated value, returning 0.001.

Normality test theory for d4
Warning: P is less than the smallest tabulated value, returning 0.001.

Signed rank sum test between experiment and theory for d4rank sum test between experiment and theory d4K
```

```
[~,~,~,~,~,d5Stats] =scatterplot_stats(d5);
```

```
Normality test experiment for d5
Warning: P is less than the smallest tabulated value, returning 0.001.

Normality test theory for d5
Warning: P is less than the smallest tabulated value, returning 0.001.

Signed rank sum test between experiment and theory for d5rank sum test between experiment and theory d5K
```

```
[~,~,~,~,~,d6Stats] =scatterplot_stats(d6);
```

```
Normality test experiment for d6
Warning: P is less than the smallest tabulated value, returning 0.001.

Normality test theory for d6
Warning: P is less than the smallest tabulated value, returning 0.001.

Signed rank sum test between experiment and theory for d6rank sum test between experiment and theory d6K
```

```
[~,~,~,~,~,d7Stats] =scatterplot_stats(d7);
```

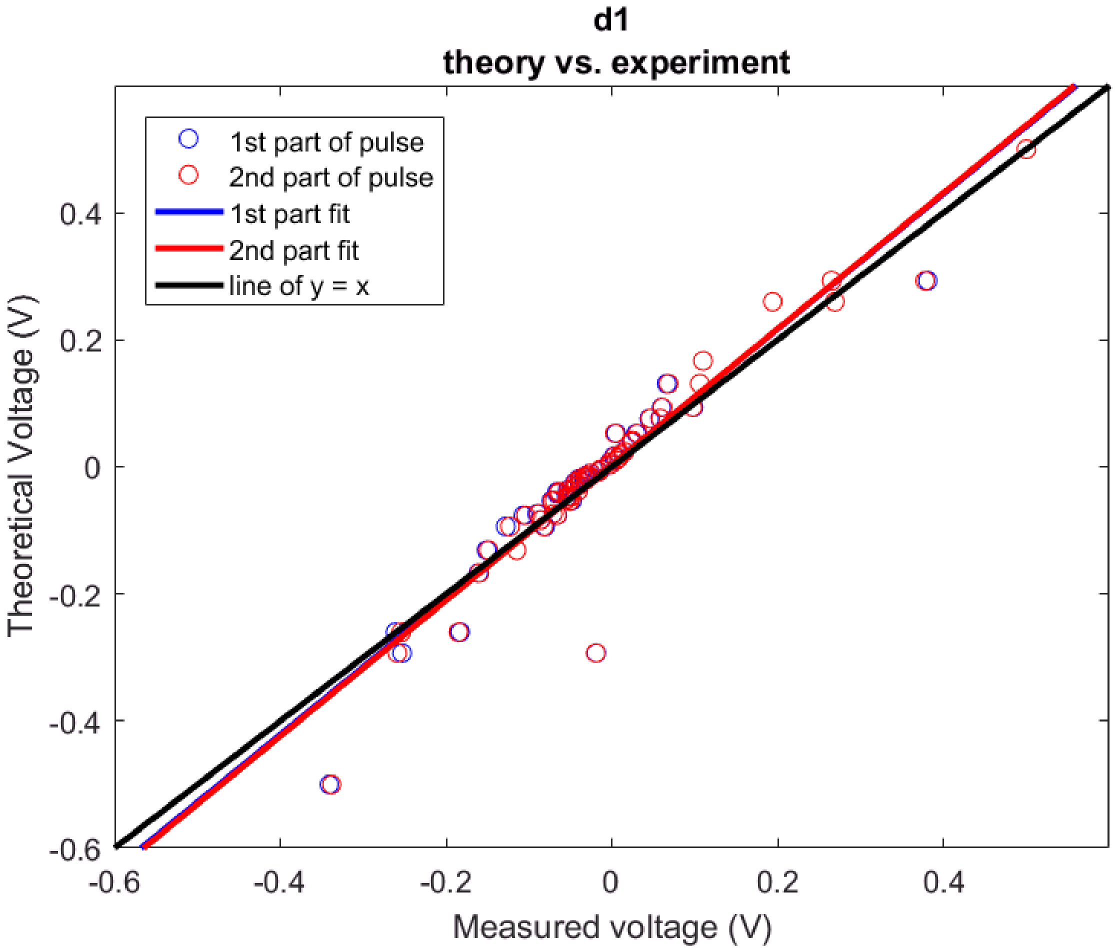
```
Normality test experiment for d7
Warning: P is less than the smallest tabulated value, returning 0.001.

Normality test theory for d7
Warning: P is less than the smallest tabulated value, returning 0.001.

Signed rank sum test between experiment and theory for d7rank sum test between experiment and theory d7K
```

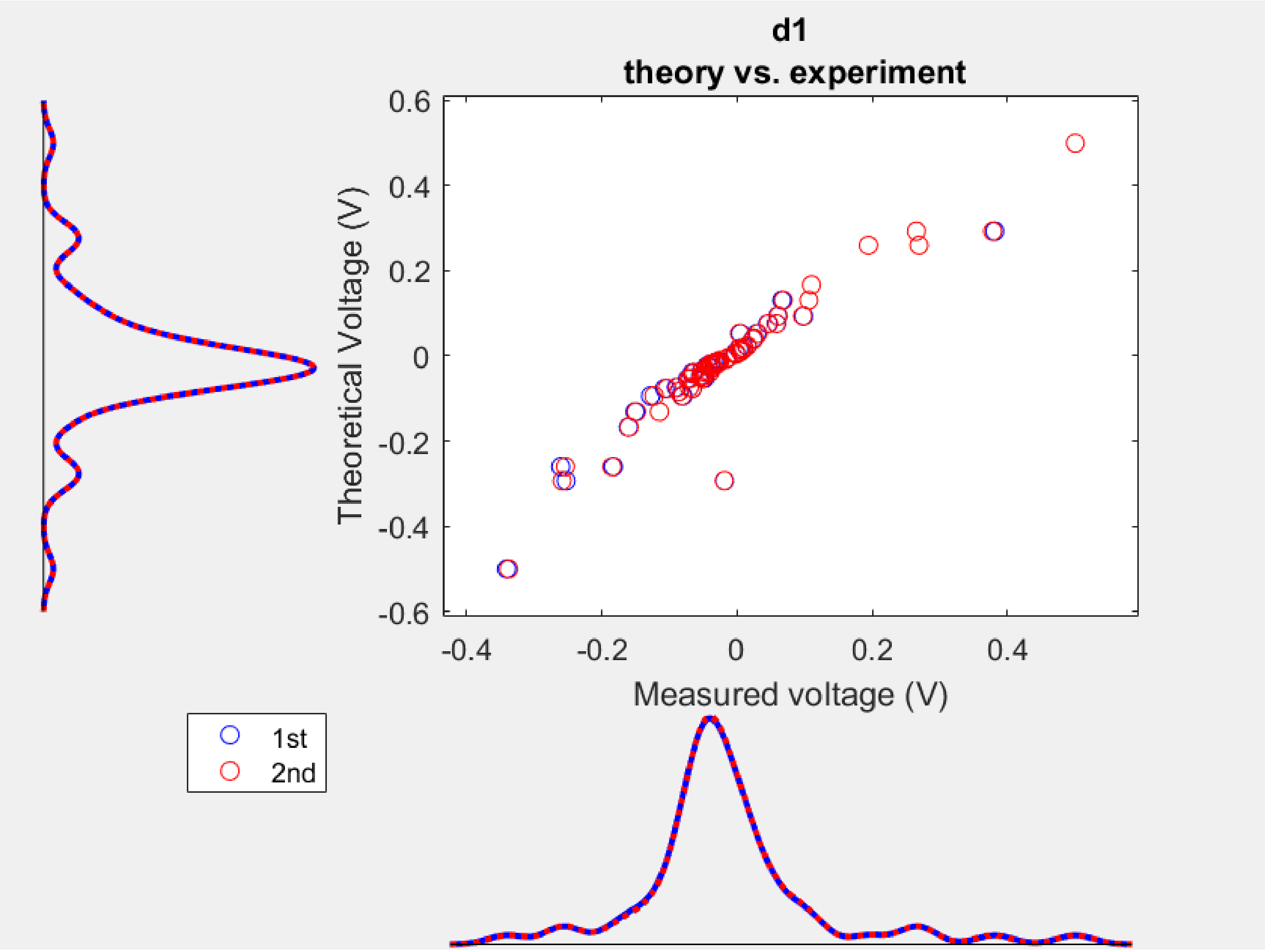
```
names = {'d1','d2','d3','d4','d5','d6','d7'};
vars = {'Lilliefors Experiment','Lilliefors; Theory','Signed rank sum','rank sum','kolmogorov
sumTable = table(d1Stats',d2Stats',d3Stats',d4Stats',d5Stats',d6Stats',d7Stats','variableNames
```

```
sumTable =
                                 d1           d2           d3          d4           d5          d6
                             __________   __________   __________   ________   __________   _______

    Lilliefors Experiment         0.001        0.001        0.001      0.001        0.001       0.00
    Lilliefors; Theory            0.001        0.001        0.001      0.001        0.001       0.00
    Signed rank sum          1.4245e-07   5.5494e-12   5.2046e-20   0.026747   1.7741e-13   0.05598
    rank sum                     0.3813     0.053743    0.0083632    0.19407   8.7652e-05      0.264
    kolmogorov smirnov          0.23601    0.0017966    0.0028903    0.13403   4.0077e-07   0.01638
```

```
% call scatter plot functs

scatterplot_func(d1)
```

```
curve1_1st =
     Linear model Poly1:
     curve1_1st(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =       1.064  (0.9704, 1.157)
       p2 =    0.004107  (-0.008208, 0.01642)
gof1_1st =
           sse: 0.1393
       rsquare: 0.8965
           dfe: 60
    adjrsquare: 0.8948
          rmse: 0.0482

curve1_2nd =
     Linear model Poly1:
     curve1_2nd(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =       1.069  (0.976, 1.161)
       p2 =     0.00353  (-0.008648, 0.01571)
gof1_2nd =
           sse: 0.1364
       rsquare: 0.8987
           dfe: 60
    adjrsquare: 0.8970
          rmse: 0.0477

ans =
     Linear model Poly1:
     ans(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =       1.064  (0.9704, 1.157)
       p2 =    0.004107  (-0.008208, 0.01642)
```

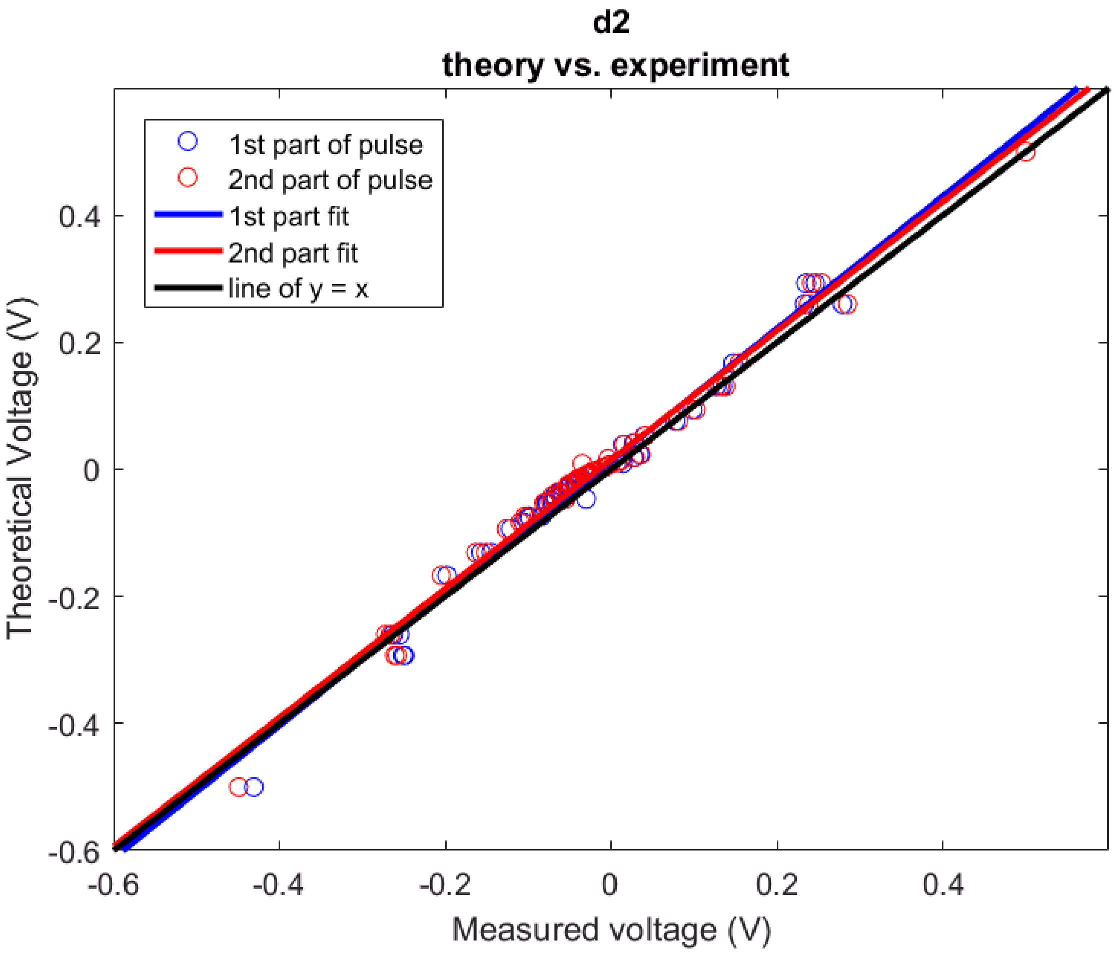

d1
theory vs. experiment
1st part of pulse
2nd part of pulse
1st part fit
2nd part fit
line of y = x
Theoretical Voltage (V)
0.4
0.2
0
-0.2
-0.4
-0.6
-0.6
-0.4
-0.2
0
0.2
0.4
Measured voltage (V)

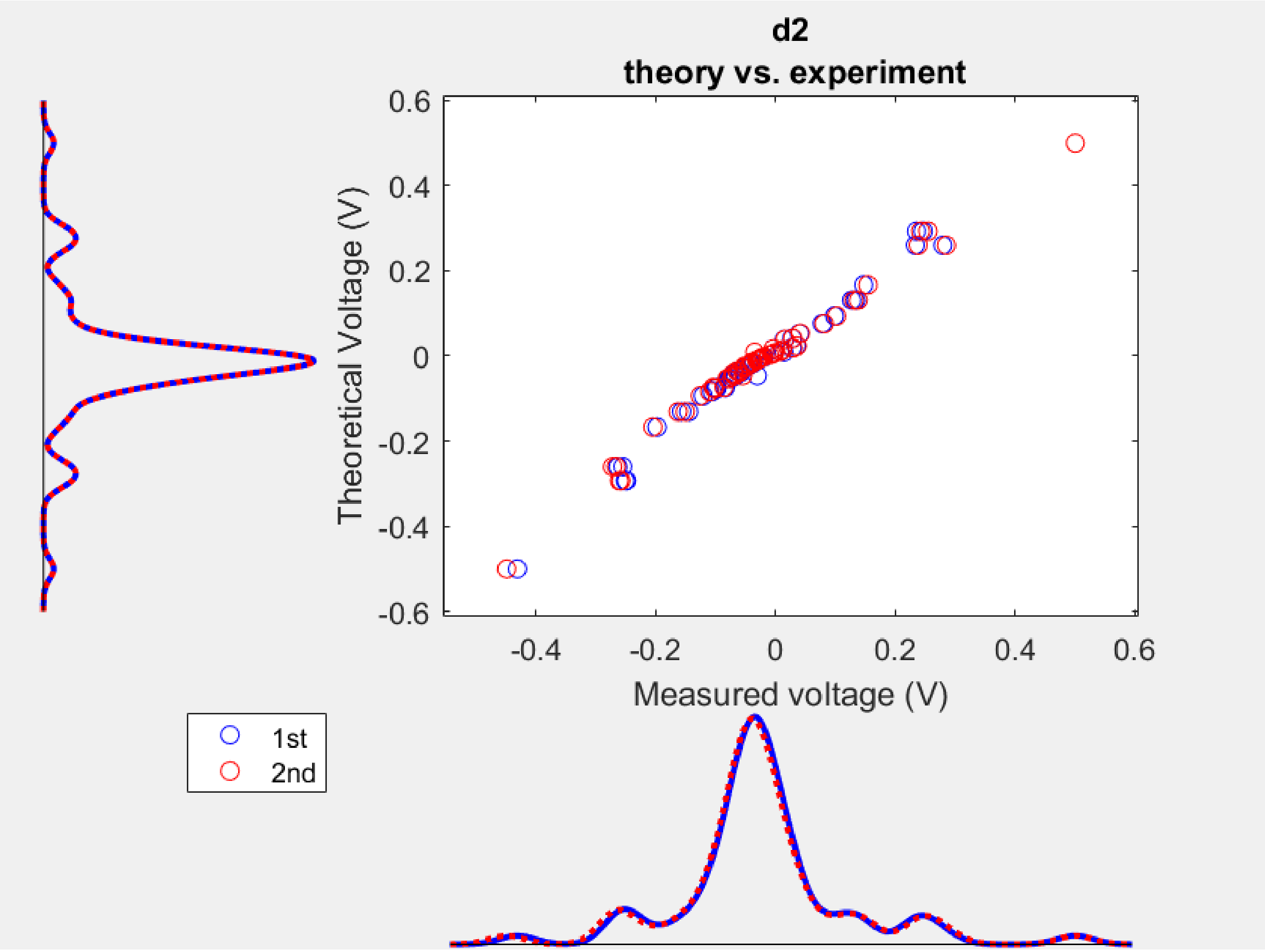


```
scatterplot_func(d2)
```

```
curve1_1st =
     Linear model Poly1:
     curve1_1st(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =       1.042  (1.007, 1.078)
       p2 =     0.01338  (0.008407, 0.01836)
gof1_1st =
           sse: 0.0224
       rsquare: 0.9829
           dfe: 60
    adjrsquare: 0.9826
          rmse: 0.0193


curve1_2nd =
     Linear model Poly1:
     curve1_2nd(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =       1.015  (0.9816, 1.048)
       p2 =     0.01536  (0.01057, 0.02015)
gof1_2nd =
           sse: 0.0207
       rsquare: 0.9842
           dfe: 60
    adjrsquare: 0.9840
          rmse: 0.0186


ans =
     Linear model Poly1:
     ans(x) = p1*x + p2
```

```
Coefficients (with 95% confidence bounds):
  p1 =       1.042  (1.007, 1.078)
  p2 =     0.01338  (0.008407, 0.01836)
```

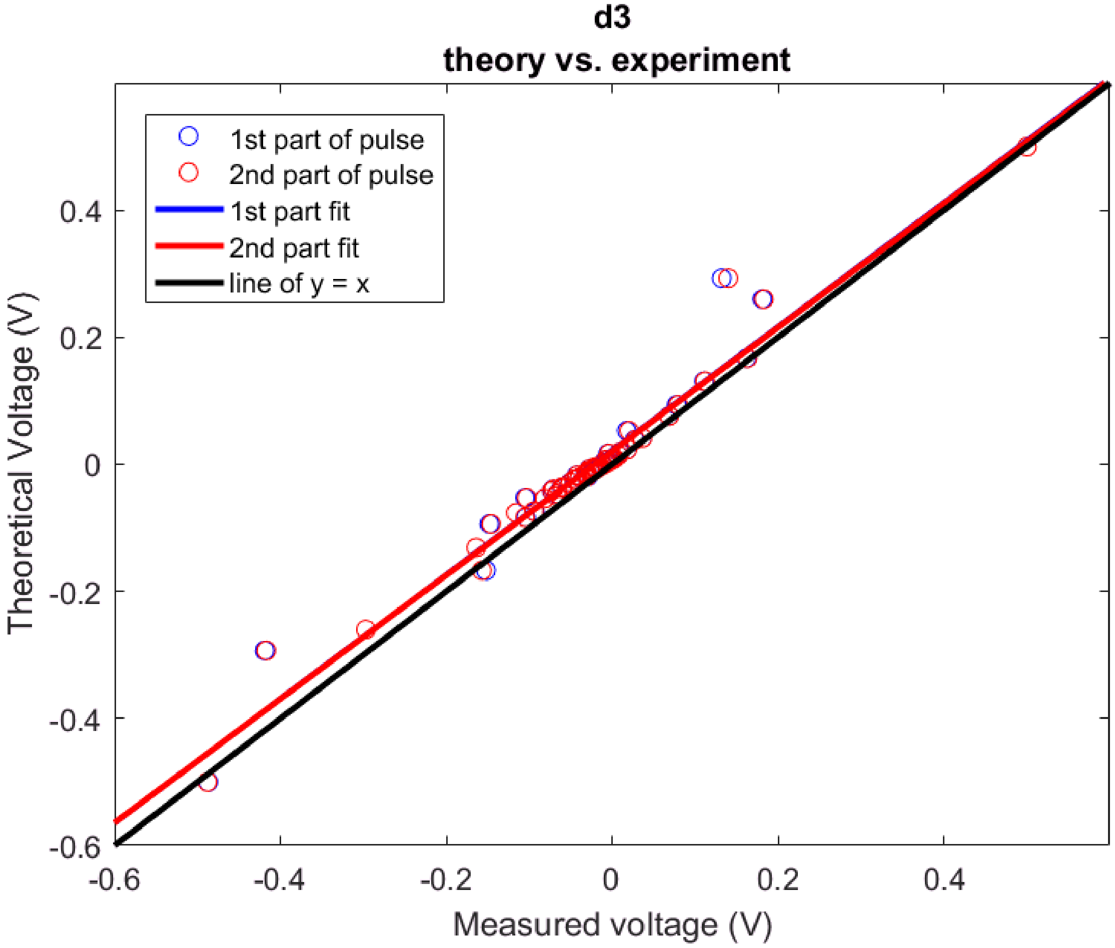


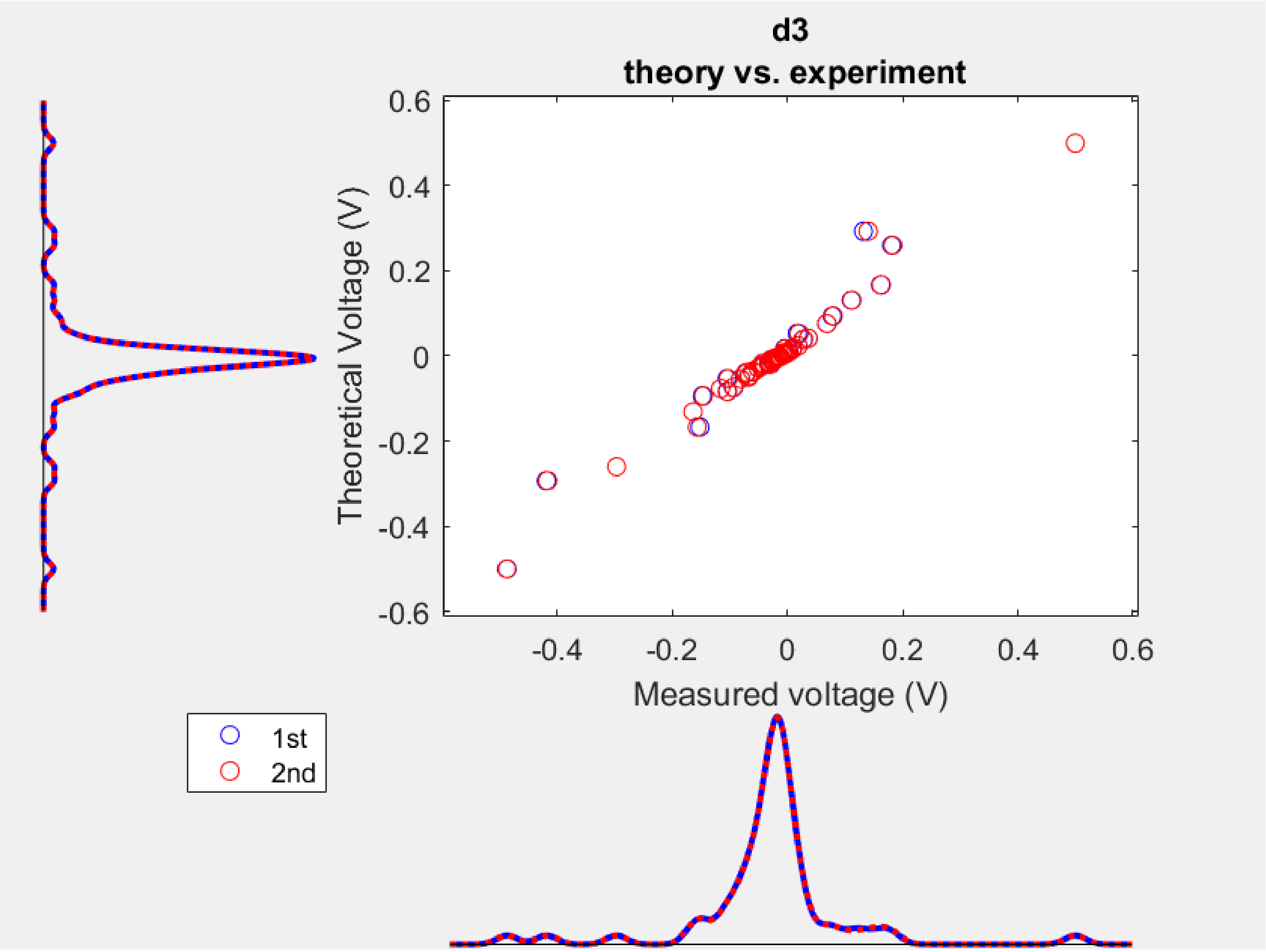


```
scatterplot_func(d3)
```

```
curve1_1st = 
     Linear model Poly1:
     curve1_1st(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =      0.9759  (0.9214, 1.03)
       p2 =     0.02118  (0.01418, 0.02818)
gof1_1st = 
           sse: 0.0431
       rsquare: 0.9553
           dfe: 60
    adjrsquare: 0.9545
          rmse: 0.0268


curve1_2nd = 
     Linear model Poly1:
     curve1_2nd(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =       0.975  (0.9227, 1.027)
       p2 =     0.02068  (0.01397, 0.0274)
gof1_2nd = 
           sse: 0.0397
       rsquare: 0.9588
           dfe: 60
    adjrsquare: 0.9581
          rmse: 0.0257


ans = 
     Linear model Poly1:
     ans(x) = p1*x + p2
```

```
Coefficients (with 95% confidence bounds):
  p1 =      0.9759  (0.9214, 1.03)
  p2 =     0.02118  (0.01418, 0.02818)
```

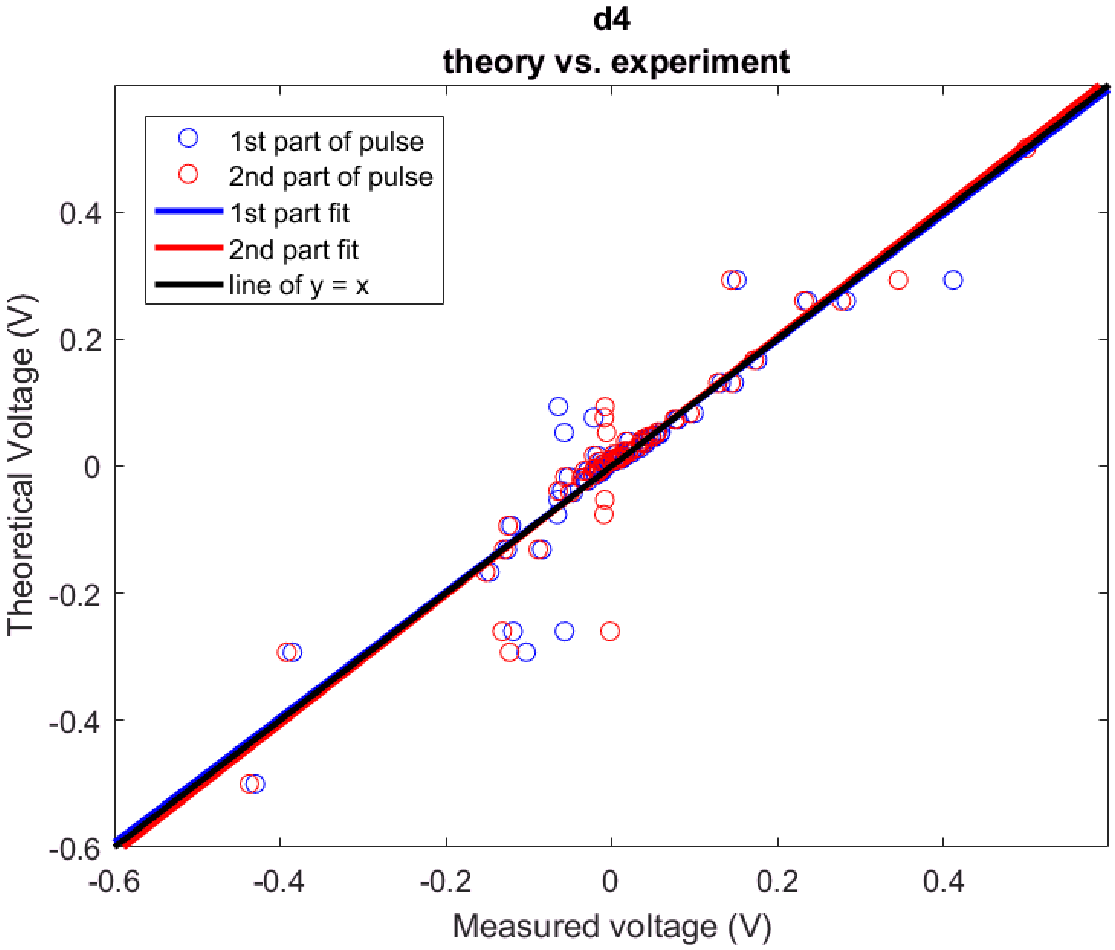


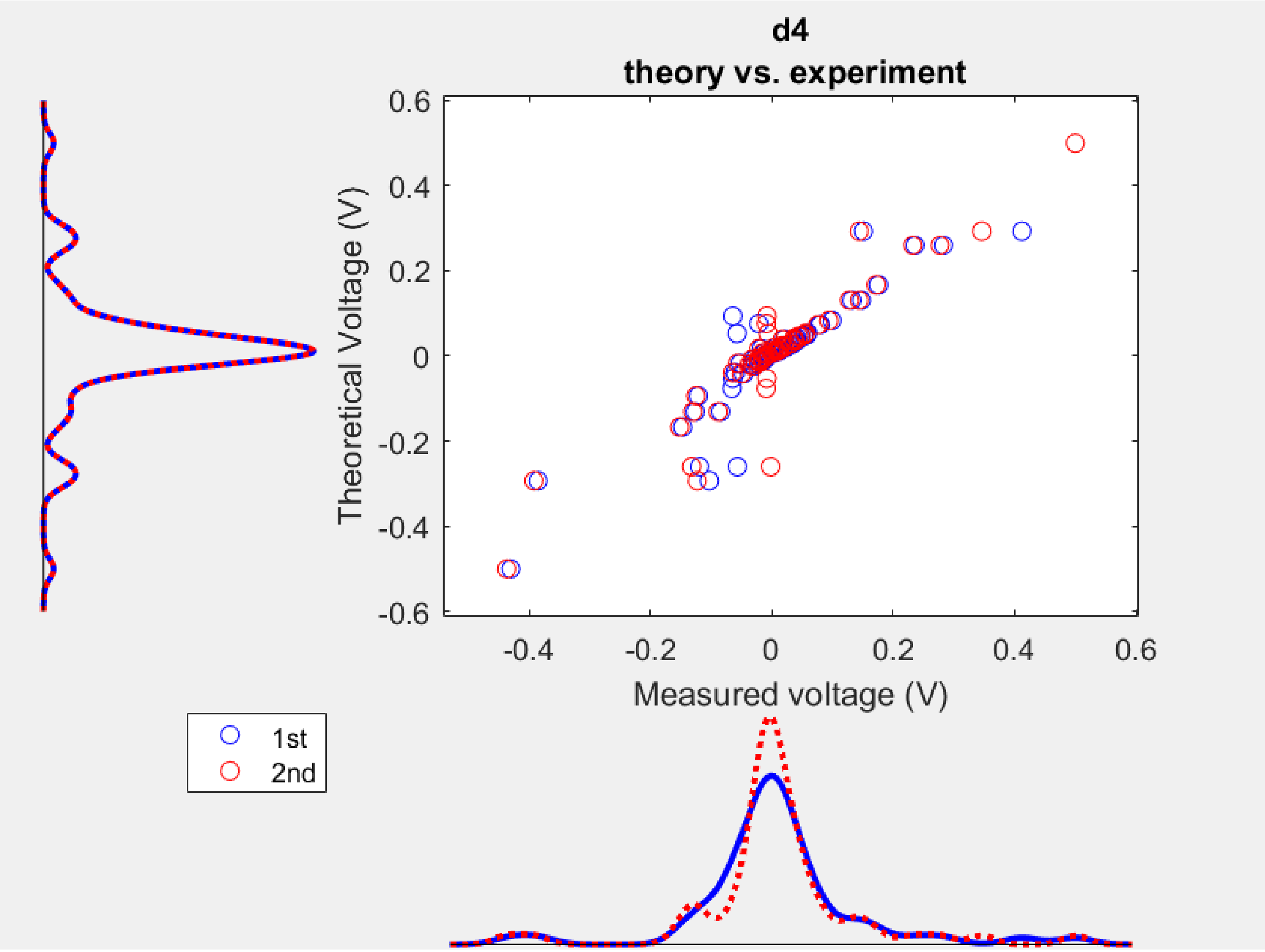


```
scatterplot_func(d4)
```

```
curve1_1st =
     Linear model Poly1:
     curve1_1st(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =      0.9872  (0.8783, 1.096)
       p2 =   0.0002869  (-0.0145, 0.01508)
gof1_1st =
           sse: 0.2022
       rsquare: 0.8455
           dfe: 60
    adjrsquare: 0.8430
          rmse: 0.0581


curve1_2nd =
     Linear model Poly1:
     curve1_2nd(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =        1.02  (0.9114, 1.128)
       p2 =   0.0001723  (-0.01415, 0.01449)
gof1_2nd =
           sse: 0.1896
       rsquare: 0.8551
           dfe: 60
    adjrsquare: 0.8527
          rmse: 0.0562


ans =
     Linear model Poly1:
     ans(x) = p1*x + p2
```

```
Coefficients (with 95% confidence bounds):
  p1 =      0.9872  (0.8783, 1.096)
  p2 =   0.0002869  (-0.0145, 0.01508)
```

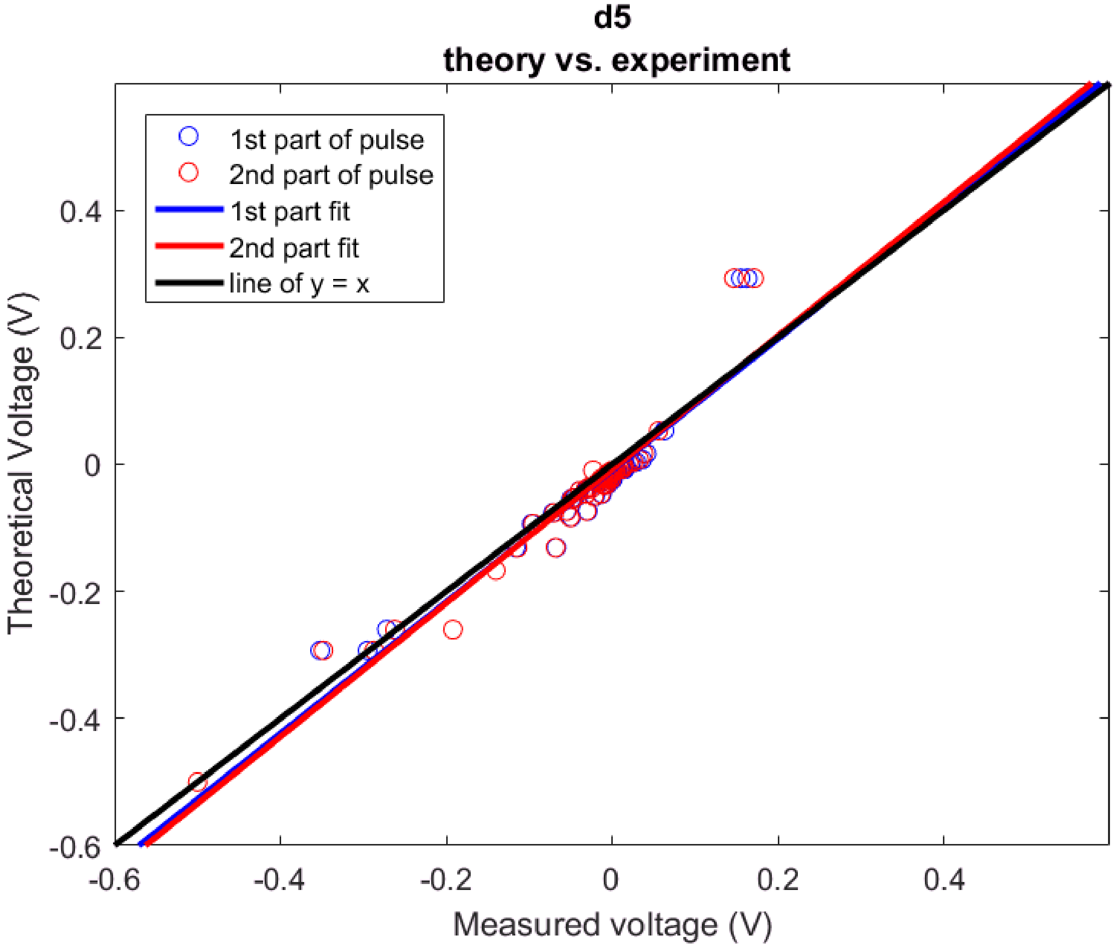


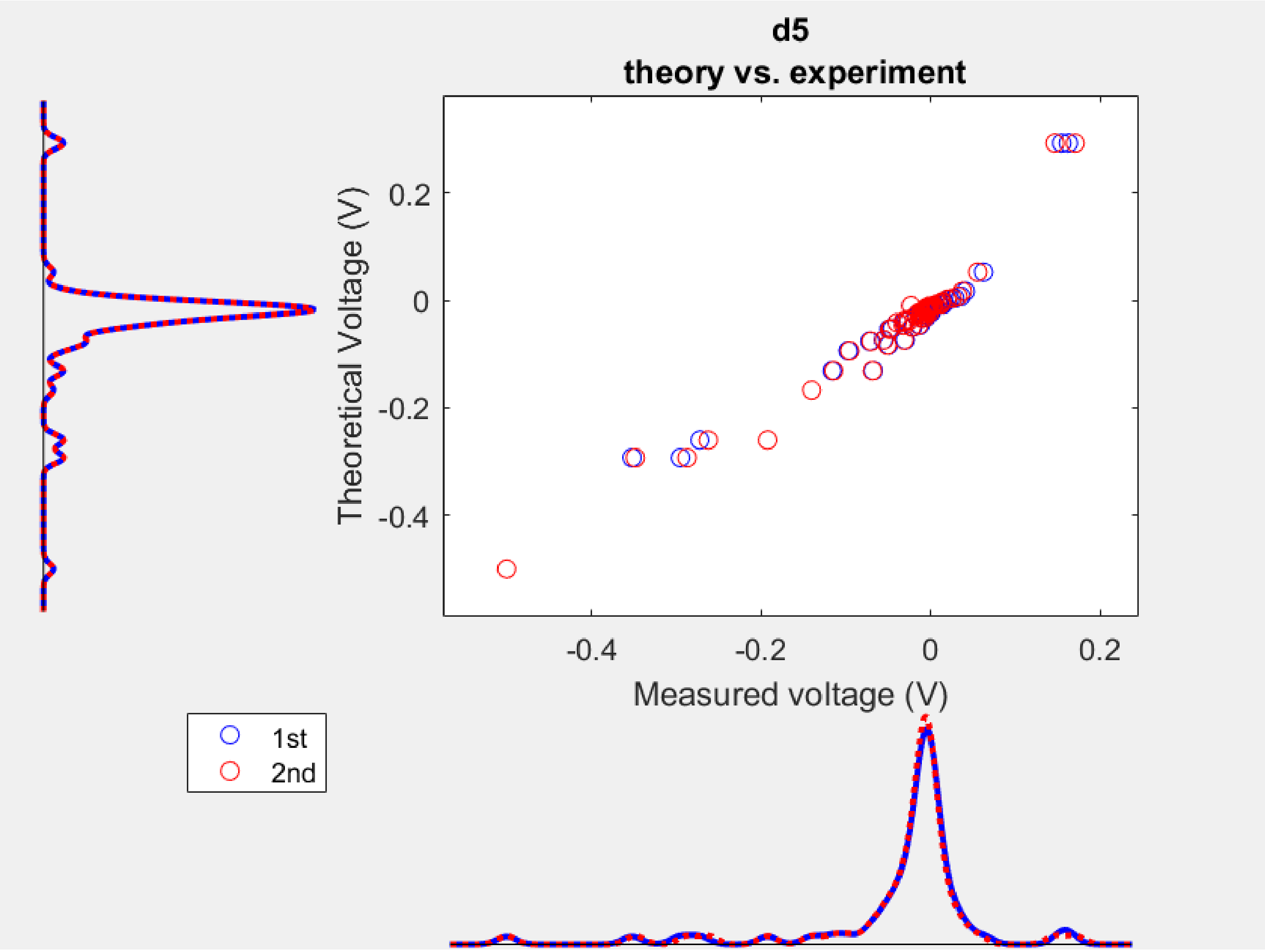


```
scatterplot_func(d5)
```

```
curve1_1st = 
     Linear model Poly1:
     curve1_1st(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =       1.035  (0.956, 1.114)
       p2 =   -0.009392  (-0.0178, -0.000987)
gof1_1st = 
           sse: 0.0591
       rsquare: 0.9196
           dfe: 60
    adjrsquare: 0.9183
          rmse: 0.0314


curve1_2nd = 
     Linear model Poly1:
     curve1_2nd(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =       1.052  (0.974, 1.13)
       p2 =   -0.008004  (-0.01623, 0.0002264)
gof1_2nd = 
           sse: 0.0563
       rsquare: 0.9235
           dfe: 60
    adjrsquare: 0.9223
          rmse: 0.0306


ans = 
     Linear model Poly1:
     ans(x) = p1*x + p2
```

```
Coefficients (with 95% confidence bounds):
  p1 =       1.035  (0.956, 1.114)
  p2 =   -0.009392  (-0.0178, -0.000987)
```

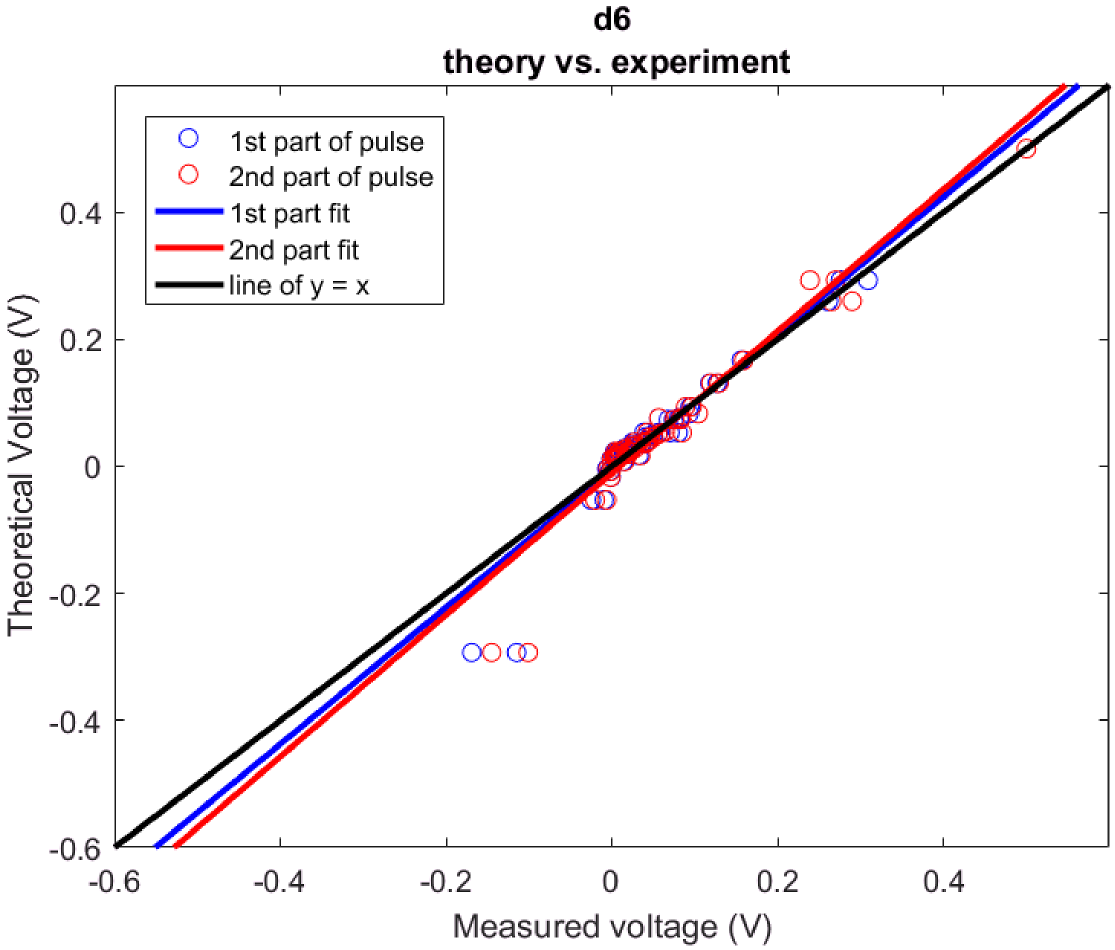


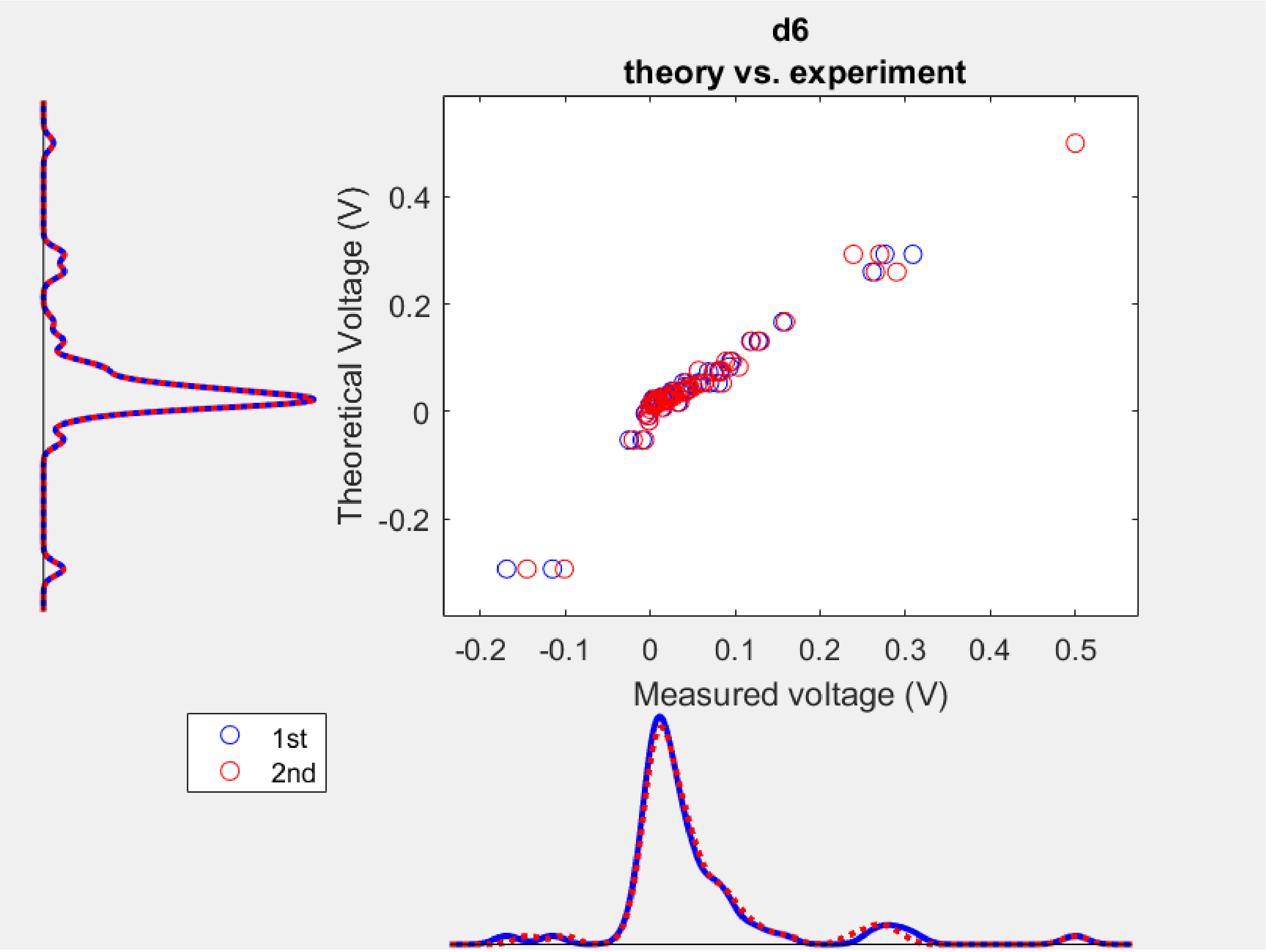


```
scatterplot_func(d6)
```

```
curve1_1st = 
     Linear model Poly1:
     curve1_1st(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =       1.077  (0.9991, 1.154)
       p2 =   -0.006583  (-0.01511, 0.001941)
gof1_1st = 
           sse: 0.0531
       rsquare: 0.9280
           dfe: 60
    adjrsquare: 0.9268
          rmse: 0.0297


curve1_2nd = 
     Linear model Poly1:
     curve1_2nd(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =       1.116  (1.028, 1.205)
       p2 =    -0.01055  (-0.02003, -0.001079)
gof1_2nd = 
           sse: 0.0633
       rsquare: 0.9141
           dfe: 60
    adjrsquare: 0.9127
          rmse: 0.0325


ans = 
     Linear model Poly1:
     ans(x) = p1*x + p2
```

```
Coefficients (with 95% confidence bounds):
  p1 =       1.077  (0.9991, 1.154)
  p2 =   -0.006583  (-0.01511, 0.001941)
```

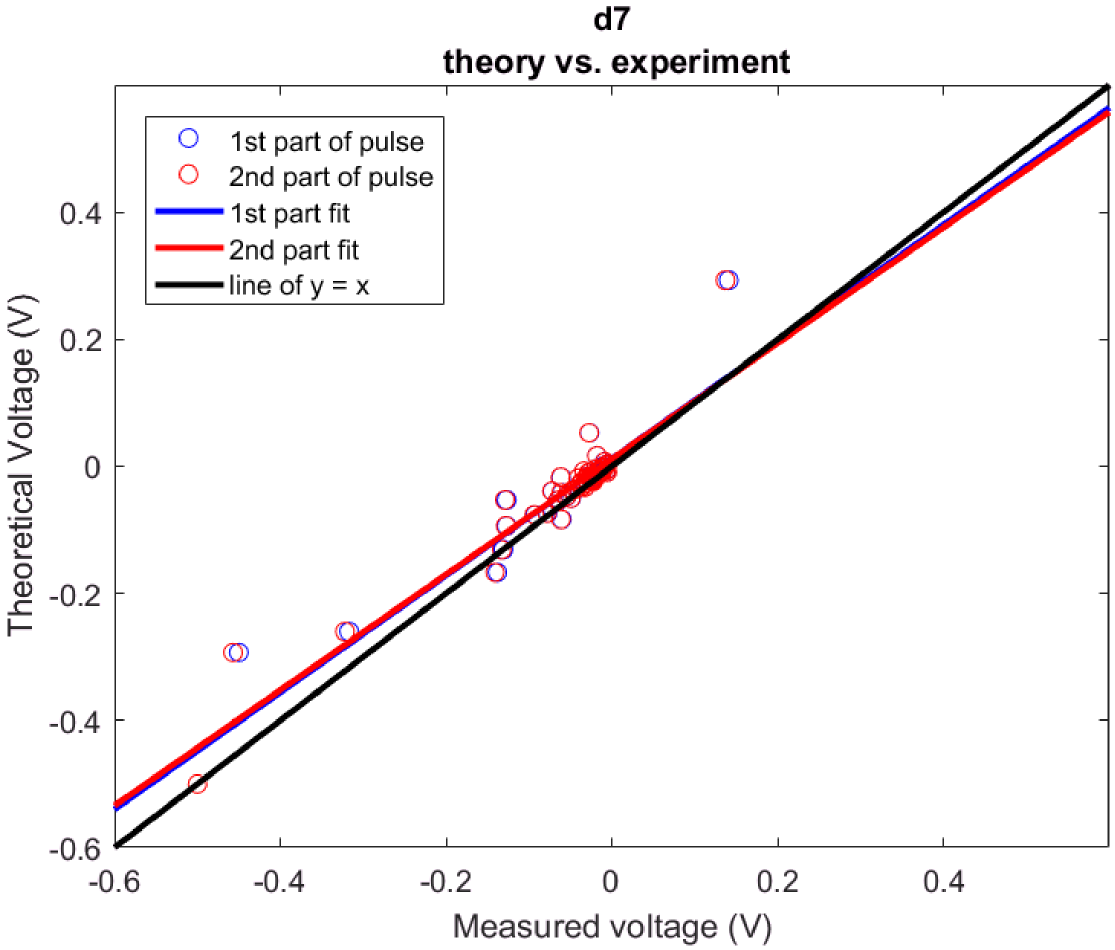


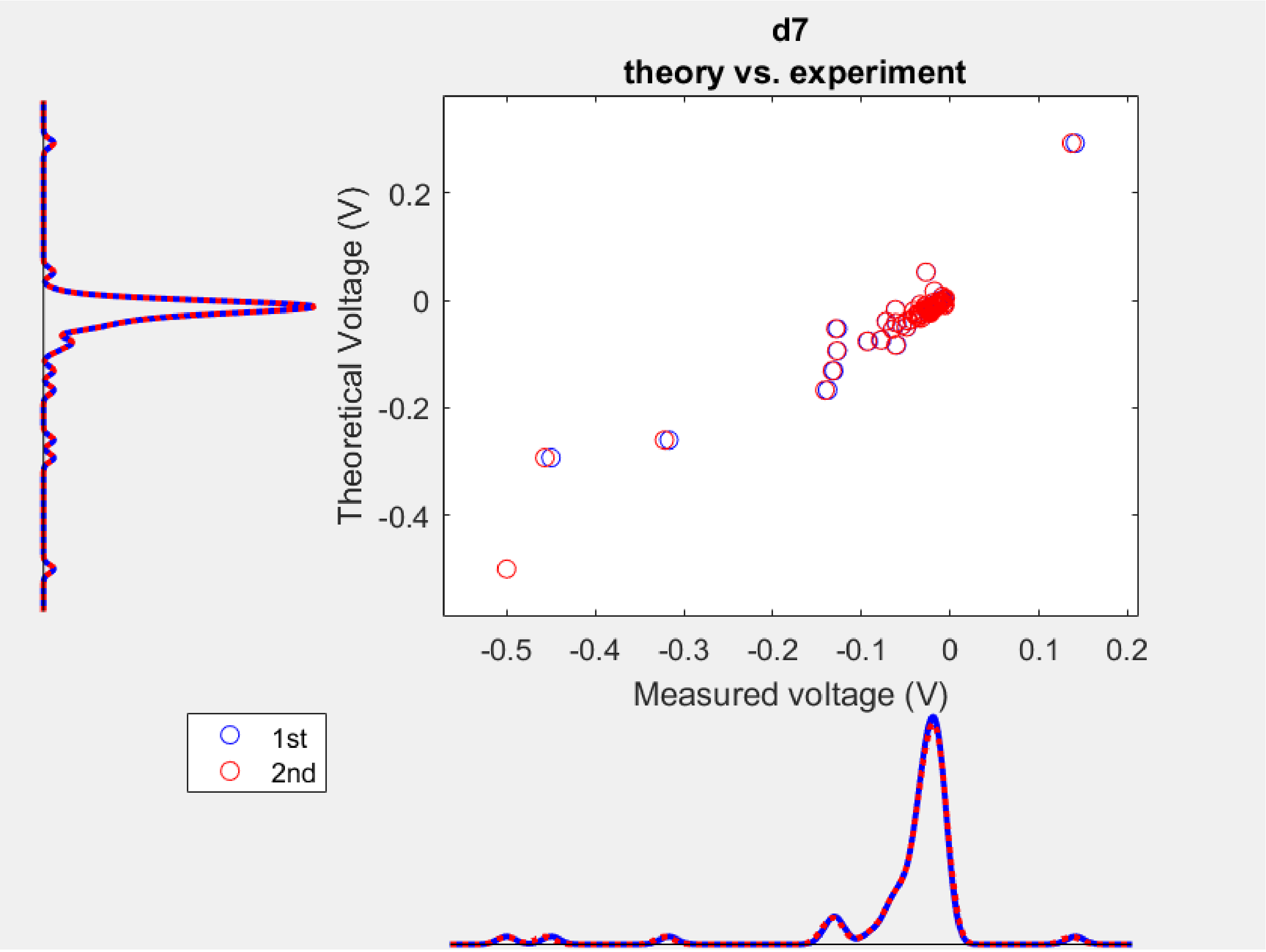


```
scatterplot_func(d7)
```

```
curve1_1st = 
     Linear model Poly1:
     curve1_1st(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =      0.9201  (0.8379, 1.002)
       p2 =     0.01217  (0.003389, 0.02095)
gof1_1st = 
           sse: 0.0547
       rsquare: 0.8932
           dfe: 60
    adjrsquare: 0.8914
          rmse: 0.0302


curve1_2nd = 
     Linear model Poly1:
     curve1_2nd(x) = p1*x + p2
     Coefficients (with 95% confidence bounds):
       p1 =      0.9098  (0.8264, 0.9932)
       p2 =     0.01192  (0.002937, 0.02091)
gof1_2nd = 
           sse: 0.0574
       rsquare: 0.8881
           dfe: 60
    adjrsquare: 0.8862
          rmse: 0.0309


ans = 
     Linear model Poly1:
     ans(x) = p1*x + p2
```

```
Coefficients (with 95% confidence bounds):
  p1 =      0.9201  (0.8379, 1.002)
  p2 =     0.01217  (0.003389, 0.02095)
```




d7
theory vs. experiment
Theoretical Voltage (V)
0.2
0
-0.2
-0.4
Measured voltage (V)
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
1st
2nd