Table of Contents

add working path of tools and functions

```
%addpath(genpath('e:\research\Tools\spot-slim'))
% addpath(genpath('e:\research\Tools\pSPOT'))
cd ../../../../../pqnl1;
addpath(genpath(pwd))
rmpath(genpath('./minConF'))
cd ../experiments/help_spgl1/modifying/task12illconditioned
addpath(genpath(pwd))
cd ./convolution
rmpath('/Volumes/Users/linamiao/Dropbox/PQN/pqnl1/minConF/')
```

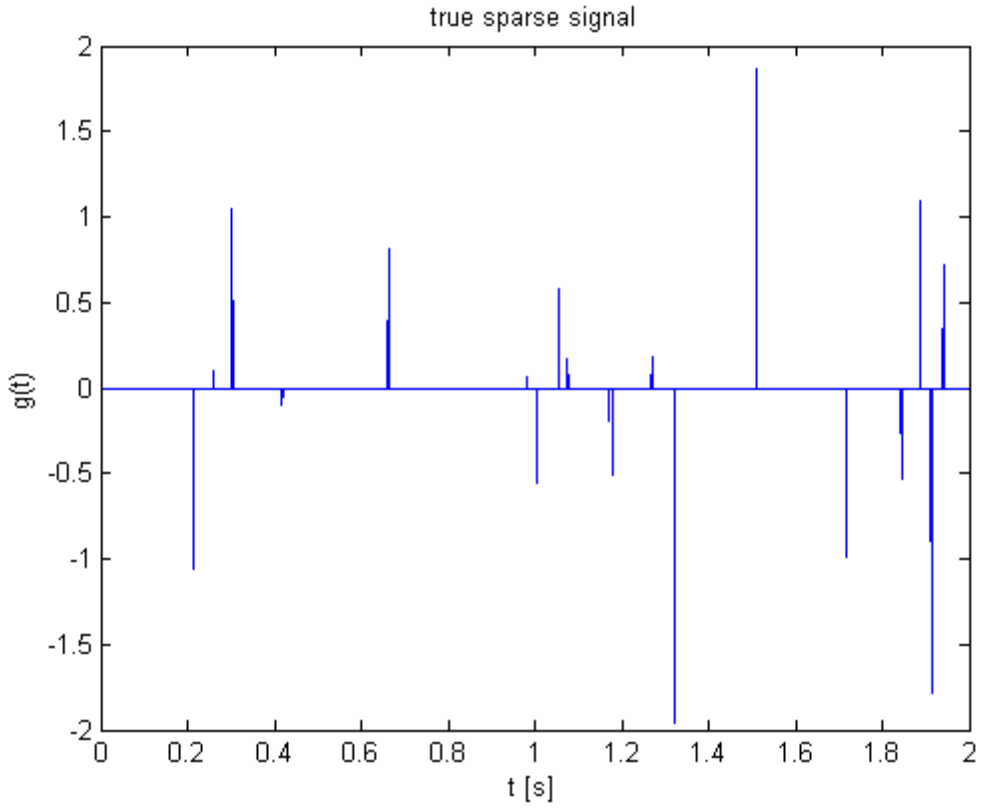
```
Warning: ".\minConF" not found in path.
Warning: ".\minConF\html" not found in path.
Warning:
"\Volumes\Users\linamiao\Dropbox\PQN\pqnl1\minConF"
not found in path.
```

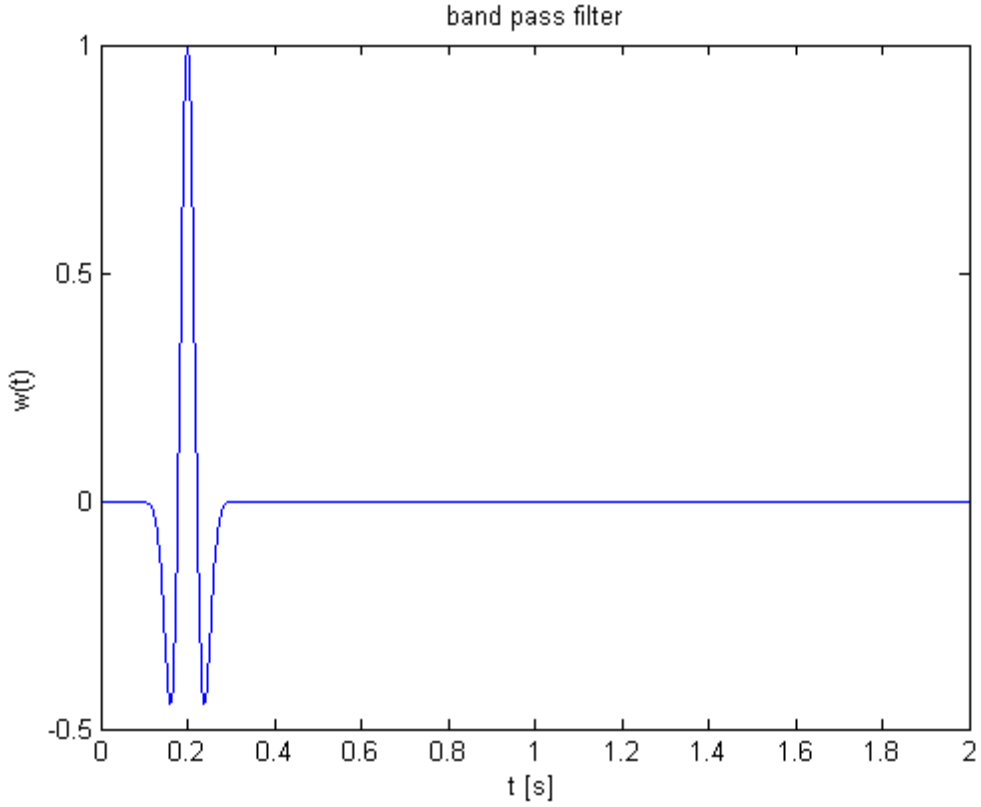
problem setting

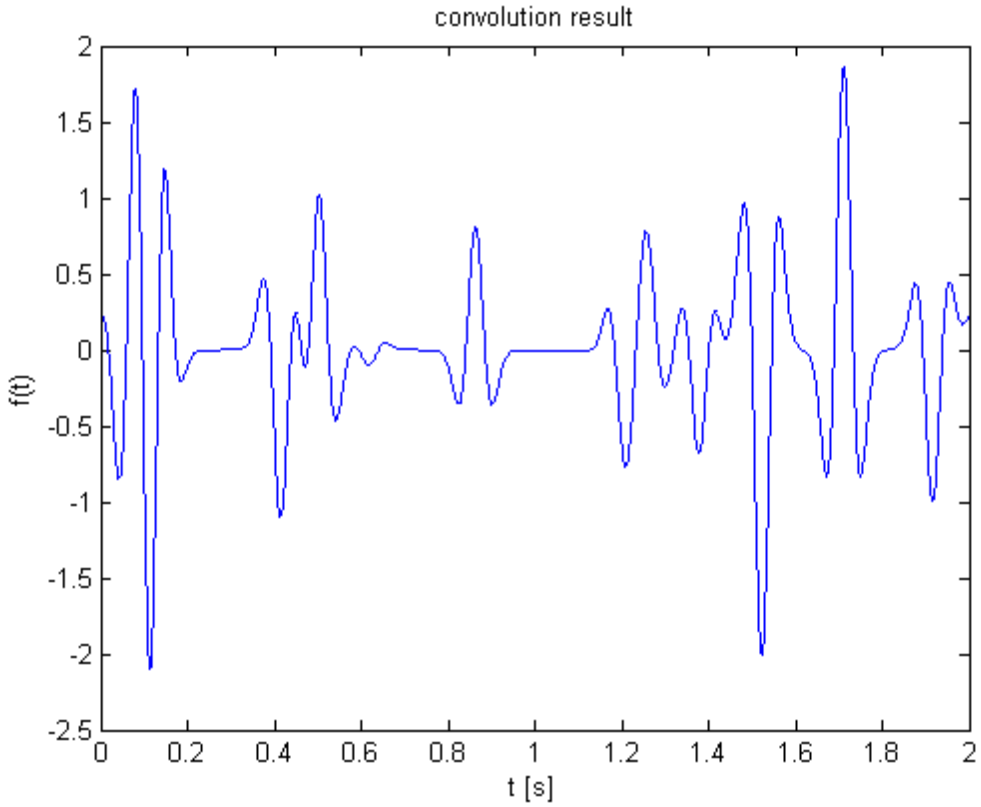
time axis

```
t = [0:.001:2]';
N = length(t);

% true signal g has approx k spikes with random amplitudes
k = 20;
g = zeros(N,1);
g(randi(N,k,1)) = randn(k,1);

% filter
w = (1-2*1e3*(t-.2).^2).*exp(-1e3*(t-.2).^2);

% plot
figure;
plot(t,g);
xlabel('t [s]');ylabel('g(t)');
title('true sparse signal')

figure;
plot(t,w);
xlabel('t [s]');ylabel('w(t)');
title('band pass filter')


% fourier transform of w
```

```
wf = fft(w);

% SPOT operator to perform convolution.
C = opDFT(N)'*opDiag(wf)*opDFT(N);
f = C*g;

% plot
figure;
plot(t,f);
xlabel('t [s]');ylabel('f(t)');
title('convolution result')
```




band pass filter
w(t)
t [s]
1
0.5
0
-0.5
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2


convolution result
f(t)
t [s]
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2

spgl1 and pqnl1

lasso

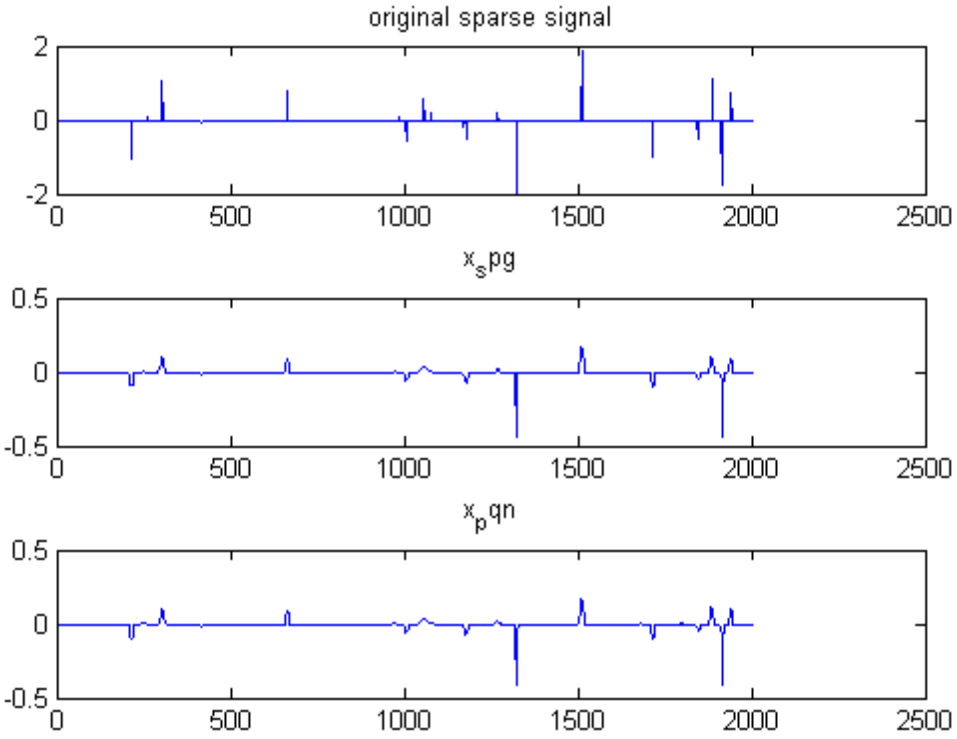
```
opts.iterations = 100;
tau = norm(g,1);

[x_spg,r_spg,g_spg,info_spg] = spgl1(C, f, tau, [], zeros(size(g)), opts);
opts.iterations = 50;
[x_pqn,r_pqn,g_pqn,info_pqn] = pqnl1_2(C, f, tau, [], zeros(size(g)), opts);

figure;
subplot(3,1,1); plot(g); title('original sparse signal')
subplot(3,1,2); plot(x_spg);title('x_spg')
subplot(3,1,3); plot(x_pqn);title('x_pqn')
```

```
================================================================================
SPGL1_SLIM v. 46  (Tue, 14 Jun 2011) based on v.1017
================================================================================
No. rows              :     2001      No. columns           :     2001
Initial tau           : 1.43e+001      Two-norm of b         : 2.35e+001
Optimality tol        : 1.00e-004      Target one-norm of x  : 1.43e+001
Basis pursuit tol     : 1.00e-006      Maximum iterations    :      100

 Iter      Objective   Relative Gap      gNorm   stepG    nnzX    nnzG
    0  2.3529958e+001  3.1588466e+000  6.11e+001     0.0       0       0
    1  2.0820452e+001  5.0807848e+000  5.53e+001    -0.3      15       0
    2  1.3576018e+001  5.0502260e+000  3.39e+001    -0.3     402       0
    3  8.9032066e+000  1.0918678e+001  2.74e+001     0.0     818       0
    4  4.8365426e+000  5.7834344e+000  7.79e+000     0.0     743       0
    5  4.2822597e+000  6.8512774e+000  6.82e+000     0.0     691       0
    6  3.5148618e+000  9.5494866e+000  6.07e+000     0.0     595       0
    7  2.5289054e+000  1.4269060e+001  4.62e+000     0.0     430       0
    8  4.2753350e+000  2.6953351e+001  1.72e+001     0.0     458       0
    9  3.3154544e+000  1.7682722e+001  8.51e+000     0.0     517       0
   10  2.0973101e+000  2.1639131e+001  4.57e+000     0.0     604       0
   11  1.8544152e+000  1.1007472e+001  2.54e+000     0.0     511       0
   12  1.7471051e+000  1.2827858e+001  2.48e+000     0.0     469       0
   13  1.4583854e+000  1.5902740e+001  2.36e+000     0.0     398       0
   14  1.5939618e+000  3.8693162e+001  3.96e+000    -0.3     422       0
   15  1.5470153e+000  3.4698573e+001  4.37e+000     0.0     408       0
   16  1.2799864e+000  1.7816578e+001  2.15e+000     0.0     388       0
   17  1.2466184e+000  9.3090085e+000  1.61e+000     0.0     387       0
   18  1.2211304e+000  8.4622709e+000  1.53e+000     0.0     389       0
   19  1.0029250e+000  1.2095765e+001  1.83e+000     0.0     352       0
   20  1.0310537e+000  2.4623170e+001  2.47e+000    -0.3     355       0
   21  9.6606291e-001  1.2659625e+001  1.78e+000     0.0     351       0
   22  9.3858080e-001  5.8955298e+000  1.24e+000     0.0     348       0
   23  9.3004761e-001  4.0322517e+000  1.10e+000     0.0     346       0
   24  8.7951084e-001  4.1935559e+000  1.03e+000     0.0     333       0
   25  9.2632105e-001  2.9693226e+001  2.85e+000    -0.3     328       0
   26  8.2246735e-001  9.0210197e+000  1.32e+000    -0.3     331       0
   27  8.0479887e-001  4.2630720e+000  9.94e-001     0.0     327       0
   28  7.9426515e-001  3.9976597e+000  9.52e-001     0.0     324       0
   29  7.7847897e-001  5.0521838e+000  1.01e+000     0.0     321       0
   30  7.8551887e-001  1.4188404e+001  1.57e+000    -0.3     315       0
   31  7.5907514e-001  3.9523654e+000  9.18e-001    -0.3     317       0
   32  7.5364271e-001  3.1231819e+000  8.43e-001     0.0     315       0
   33  7.4815764e-001  2.4482845e+000  7.92e-001     0.0     313       0
   34  7.0956932e-001  6.3310345e+000  9.94e-001     0.0     306       0
```

35	7.1088874e-001	1.0391001e+001	1.33e+000	-0.3	306	0
36	6.9720657e-001	3.6827033e+000	8.12e-001	0.0	305	0
37	6.9326051e-001	2.1233459e+000	7.12e-001	0.0	305	0
38	6.8971031e-001	1.8485805e+000	6.86e-001	0.0	303	0
39	6.5750179e-001	7.9441185e+000	1.10e+000	0.0	295	0
40	6.6213946e-001	8.3270477e+000	1.07e+000	-0.3	294	0
41	6.4550535e-001	2.5476383e+000	7.00e-001	0.0	294	0
42	6.4277710e-001	1.5009406e+000	6.16e-001	0.0	294	0
43	6.4002485e-001	1.2897475e+000	5.97e-001	0.0	293	0
44	5.8128013e-001	3.1993994e+000	6.78e-001	0.0	288	0
45	6.2755081e-001	1.1837901e+001	1.20e+000	-0.3	290	0
46	6.0678397e-001	5.6123951e+000	8.65e-001	0.0	290	0
47	5.7601446e-001	4.6547123e+000	7.71e-001	0.0	287	0
48	5.6821019e-001	1.3807525e+000	5.29e-001	0.0	287	0
49	5.6638420e-001	1.0763691e+000	5.05e-001	0.0	287	0
50	5.5741503e-001	1.6924596e+000	5.30e-001	0.0	286	0
51	5.5714761e-001	3.0333829e+000	6.26e-001	-0.3	287	0
52	5.5372223e-001	2.2119541e+000	5.58e-001	0.0	286	0
53	5.5112945e-001	1.2853433e+000	5.00e-001	0.0	285	0
54	5.4998050e-001	1.0490423e+000	4.80e-001	0.0	284	0
55	5.4416179e-001	1.2468718e+000	4.91e-001	0.0	285	0
56	5.4705597e-001	5.9079396e+000	7.90e-001	-0.3	281	0
57	5.4533623e-001	4.1097830e+000	7.04e-001	-0.3	282	0
58	5.3612072e-001	9.1873172e-001	4.59e-001	0.0	282	0
59	5.3505376e-001	8.7267042e-001	4.55e-001	0.0	284	0
60	5.3324840e-001	1.0138084e+000	4.61e-001	0.0	283	0
61	5.2563067e-001	1.0928578e+001	1.16e+000	0.0	284	0
62	5.1699152e-001	4.7669257e+000	6.92e-001	-0.3	284	0
63	5.0246598e-001	1.9765968e+000	5.13e-001	0.0	284	0
64	5.0086143e-001	7.7265733e-001	4.21e-001	0.0	285	0
65	4.9970097e-001	7.3111155e-001	4.13e-001	0.0	285	0
66	4.8891390e-001	3.0945775e+000	5.51e-001	0.0	284	0
67	4.9254002e-001	5.5778473e+000	7.65e-001	-0.3	283	0
68	4.8720876e-001	2.3066500e+000	5.02e-001	0.0	282	0
69	4.8445864e-001	1.0210786e+000	4.19e-001	0.0	282	0
70	4.8387206e-001	7.3010836e-001	3.96e-001	0.0	281	0
71	4.8052696e-001	7.7588647e-001	3.95e-001	0.0	282	0
72	4.6410925e-001	5.9318594e+000	7.15e-001	-0.3	269	0
73	4.5370305e-001	5.6852373e+000	6.99e-001	-0.3	269	0
74	4.3817303e-001	1.9444287e+000	4.57e-001	0.0	270	0
75	4.3269995e-001	8.0060459e-001	3.64e-001	0.0	269	0
76	4.3181066e-001	6.5922172e-001	3.54e-001	0.0	269	0
77	4.2965209e-001	5.3018847e-001	3.38e-001	0.0	268	0
78	4.2849704e-001	1.9027007e+000	4.31e-001	0.0	266	0
79	4.2572647e-001	9.5858167e-001	3.66e-001	-0.3	266	0
80	4.2509574e-001	5.1675849e-001	3.32e-001	0.0	266	0
81	4.2448726e-001	5.9713957e-001	3.36e-001	0.0	266	0
82	4.2273015e-001	1.2261809e+000	3.72e-001	0.0	266	0
83	4.2162146e-001	9.4015833e-001	3.59e-001	-0.3	266	0
84	4.2117991e-001	5.1239522e-001	3.26e-001	0.0	266	0
85	4.2065559e-001	5.5088715e-001	3.29e-001	0.0	266	0
86	4.1771384e-001	2.0663101e+000	4.24e-001	0.0	267	0
87	4.1589975e-001	1.4566683e+000	3.95e-001	-0.3	266	0
88	4.1487482e-001	5.0721484e-001	3.22e-001	0.0	267	0
89	4.1456017e-001	4.9902139e-001	3.21e-001	0.0	266	0
90	4.1318118e-001	5.4899770e-001	3.22e-001	0.0	267	0
91	4.1199914e-001	2.6103480e+000	4.71e-001	-0.3	265	0
92	4.1036892e-001	5.5035818e-001	3.21e-001	-0.3	266	0
93	4.0994808e-001	5.6793697e-001	3.23e-001	0.0	266	0
94	4.0945479e-001	5.0191343e-001	3.17e-001	0.0	266	0
95	4.0508364e-001	2.3833990e+000	4.51e-001	0.0	264	0
96	4.0919541e-001	2.7241555e+000	4.59e-001	-0.3	266	0
97	4.0312164e-001	8.7851545e-001	3.41e-001	0.0	266	0
98	4.0258509e-001	4.7761815e-001	3.10e-001	0.0	266	0

```
   99  4.0213330e-001  4.8371502e-001  3.10e-001     0.0     266       0
  100  3.9112506e-001  1.4100958e+000  3.60e-001     0.0     266       0

 ERROR EXIT -- Too many iterations

 Products with A     :     142        Total time   (secs) :     0.8
 Products with A'    :     101        Project time (secs) :     0.1
 Newton iterations   :       0        Mat-vec time (secs) :     0.6
 Line search its     :      73        Subspace iterations :       0


 ================================================================================
 PQNL1_SLIM v. 46  (Tue, 14 Jun 2011) based on v.1017
 ================================================================================
 No. rows              :     2001      No. columns           :     2001
 Initial tau           : 1.43e+001      Two-norm of b         : 2.35e+001
 Optimality tol        : 1.00e-004      Target one-norm of x  : 1.43e+001
 Basis pursuit tol     : 1.00e-006      Maximum iterations    :       50

  Iter      Objective   Relative Gap      gNorm   stepG    nnzX    nnzG
     0  2.3529958e+001  3.1588466e+000  6.11e+001     0.0       0       0
Inside of minConf_PQN
 Iteration   FunEvals Projections     Step Length          rNorm2        Opt Cond
         1          1           4    5.00000e-001    2.09610e+001    2.14753e+001
         2          1          55    1.00000e+000    6.57415e+000    2.79912e+001
         3          1          92    1.00000e+000    5.21814e+000    2.64151e+001
         4          1         121    1.00000e+000    3.94063e+000    2.70519e+001
         5          1         160    1.00000e+000    2.90119e+000    2.55596e+001
         6          1         201    1.00000e+000    2.27316e+000    2.22839e+001
         7          1         244    1.00000e+000    1.92726e+000    2.12896e+001
         8          1         287    1.00000e+000    1.68437e+000    2.15570e+001
         9          1         332    1.00000e+000    1.49427e+000    1.98743e+001
        10          1         376    1.00000e+000    1.33487e+000    1.87180e+001
        11          1         411    1.00000e+000    1.18264e+000    1.54786e+001
        12          1         454    1.00000e+000    1.07118e+000    1.25133e+001
        13          1         497    1.00000e+000    9.86085e-001    1.21480e+001
        14          1         537    1.00000e+000    9.40744e-001    1.11190e+001
        15          1         565    1.00000e+000    8.88339e-001    1.09453e+001
        16          1         599    1.00000e+000    8.37637e-001    1.09697e+001
        17          1         646    1.00000e+000    7.85000e-001    1.08472e+001
        18          1         675    1.00000e+000    7.59494e-001    1.01991e+001
        19          1         713    1.00000e+000    7.29170e-001    9.90611e+000
        20          1         762    1.00000e+000    6.93805e-001    1.12292e+001
        21          1         800    1.00000e+000    6.67995e-001    1.03955e+001
        22          1         838    1.00000e+000    6.47871e-001    8.67069e+000
        23          1         876    1.00000e+000    6.33370e-001    8.63089e+000
        24          1         950    1.00000e+000    6.17713e-001    1.08165e+001
        25          1        1027    1.00000e+000    6.01209e-001    1.00918e+001
        26          1        1095    1.00000e+000    5.77826e-001    1.17660e+001
        27          1        1161    1.00000e+000    5.60637e-001    1.10513e+001
        28          1        1204    1.00000e+000    5.46588e-001    7.37465e+000
        29          1        1248    1.00000e+000    5.38093e-001    6.09126e+000
        30          1        1296    1.00000e+000    5.27406e-001    7.25642e+000
        31          1        1346    1.00000e+000    5.22267e-001    8.01011e+000
        32          1        1416    1.00000e+000    5.10696e-001    9.77963e+000
        33          1        1548    1.00000e+000    4.94793e-001    1.10708e+001
        34          1        1634    1.00000e+000    4.81022e-001    1.00594e+001
        35          1        1709    1.00000e+000    4.70840e-001    7.94137e+000
        36          1        1811    1.00000e+000    4.61679e-001    6.71235e+000
        37          1        1891    1.00000e+000    4.54669e-001    7.45216e+000
        38          1        1964    1.00000e+000    4.47368e-001    7.35913e+000
        39          1        2027    1.00000e+000    4.36998e-001    6.67185e+000
        40          1        2087    1.00000e+000    4.30635e-001    8.08466e+000
        41          1        2124    1.00000e+000    4.26909e-001    6.83717e+000
```

```
        42          1       2171    1.00000e+000    4.23076e-001    5.18441e+000
        43          1       2219    1.00000e+000    4.18699e-001    6.39069e+000
        44          1       2306    1.00000e+000    4.12106e-001    1.01201e+001
        45          1       2369    1.00000e+000    4.05374e-001    1.11437e+001
        46          1       2453    1.00000e+000    3.98541e-001    9.13457e+000
        47          1       2527    1.00000e+000    3.90886e-001    5.07155e+000
        48          1       2601    1.00000e+000    3.85163e-001    5.68249e+000
        49          1       2700    1.00000e+000    3.74925e-001    7.71156e+000
        50          1       2774    1.00000e+000    3.69730e-001    7.86265e+000
   50  3.6972957e-001  1.4524082e+000  3.48e-001     0.0     272       0
ERROR EXIT -- Too many iterations

Products with A     :      53        Total time   (secs) :     3.7
Products with A'    :      53        Project time (secs) :     4.4
Newton iterations   :       0        Mat-vec time (secs) :     0.3
```



BPDN

noisy signal

```
f = C*g+ 1e-2*randn(N,1);

% plot
figure;
plot(t,f);
xlabel('t [s]');ylabel('f(t)');
title('convolution result')
```

```
opts.iterations = 100;


[x_spg,r_spg,g_spg,info_spg] = spgl1(C, f, 0, 1e-2, zeros(size(g)), opts);
[x_pqn,r_pqn,g_pqn,info_pqn] = pqnl1_2(C, f, 0, 1-2, zeros(size(g)), opts);

figure;
subplot(3,1,1); plot(g); title('original sparse signal')
subplot(3,1,2); plot(x_spg);title('x_spg')
subplot(3,1,3); plot(x_pqn);title('x_pqn')

figure('Name','Solution paths')
plot(info_spg.xNorm1,info_spg.rNorm2,info_pqn.xNorm1,info_pqn.rNorm2);hold on
scatter(info_spg.xNorm1,info_spg.rNorm2);
scatter(info_pqn.xNorm1,info_pqn.rNorm2);hold off
legend('spg','pqn')
axis tight
```

```
================================================================================
SPGL1_SLIM v. 46  (Tue, 14 Jun 2011) based on v.1017
================================================================================
No. rows              :     2001      No. columns           :     2001
Initial tau           : 0.00e+000      Two-norm of b         : 2.35e+001
Optimality tol        : 1.00e-004      Target objective      : 1.00e-002
Basis pursuit tol     : 1.00e-006      Maximum iterations    :      100

 Iter      Objective   Relative Gap  Rel Error      gNorm   stepG    nnzX    nnzG
    0  2.3532434e+001  0.0000000e+000  1.00e+000  6.104e+001     0.0       0
    1  2.0731123e+001  2.6393817e+000  1.00e+000  6.096e+001    -0.3       1
    2  2.0181522e+001  4.9947561e+000  1.00e+000  7.194e+001    -0.3      44
    3  1.3253539e+001  2.0191155e+000  9.99e-001  2.868e+001    -0.3     303
    4  9.4071547e+000  2.4454099e+000  9.99e-001  1.689e+001     0.0     367
    5  8.2846315e+000  1.6368519e+000  9.99e-001  1.471e+001     0.0     317
    6  7.7485573e+000  6.0271348e-001  9.99e-001  1.288e+001     0.0     266
    7  7.6495994e+000  5.4289170e-001  9.99e-001  1.271e+001     0.0     234
    8  7.5221970e+000  1.3954903e+000  9.99e-001  1.568e+001     0.0     157
    9  7.3988511e+000  6.6952962e-001  9.99e-001  1.280e+001    -0.3     170
   10  7.3751020e+000  3.1573820e-001  9.99e-001  1.194e+001     0.0     162
   11  7.3583811e+000  3.4250809e-001  9.99e-001  1.200e+001     0.0     154
   12  7.3328931e+000  4.5705891e-001  9.99e-001  1.234e+001     0.0     140
   13  7.3722185e+000  1.7009063e+000  9.99e-001  1.610e+001    -0.3     138
   14  7.3298663e+000  4.2381873e-001  9.99e-001  1.219e+001     0.0     154
   15  7.2998463e+000  3.9869228e-001  9.99e-001  1.221e+001     0.0     144
   16  7.2945506e+000  2.8038235e-001  9.99e-001  1.185e+001     0.0     139
   17  7.2757394e+000  2.2272016e-001  9.99e-001  1.167e+001     0.0     130
   18  7.2685111e+000  5.3931787e-001  9.99e-001  1.259e+001    -0.3     130
   19  7.2689596e+000  4.2543904e-001  9.99e-001  1.227e+001     0.0     127
   20  7.2527661e+000  4.8043157e-001  9.99e-001  1.243e+001     0.0     125
   21  7.2466584e+000  1.4530709e-001  9.99e-001  1.146e+001     0.0     121
   22  7.2422375e+000  1.8009160e-001  9.99e-001  1.156e+001     0.0     120
   23  7.2004788e+000  4.8372390e-001  9.99e-001  1.227e+001     0.0     102
   24  7.1918848e+000  3.5280547e-001  9.99e-001  1.220e+001    -0.3     111
   25  7.1824513e+000  2.0358134e-001  9.99e-001  1.164e+001     0.0     106
   26  7.1801288e+000  9.1019714e-002  9.99e-001  1.134e+001     0.0     106
   27  7.1774683e+000  8.3380560e-002  9.99e-001  1.131e+001     0.0     105
   28  7.1539125e+000  3.9415375e-001  9.99e-001  1.196e+001     0.0      86
   29  7.1605825e+000  5.4815724e-001  9.99e-001  1.277e+001    -0.3      94
   30  7.1478413e+000  1.5592645e-001  9.99e-001  1.144e+001     0.0      89
   31  7.1452876e+000  1.2717620e-001  9.99e-001  1.141e+001     0.0      86
   32  7.1444754e+000  7.1159353e-002  9.99e-001  1.124e+001     0.0      86
   33  7.1412964e+000  7.1706217e-002  9.99e-001  1.123e+001     0.0      85
   34  7.1381906e+000  2.8752668e-001  9.99e-001  1.187e+001    -0.3      85
   35  7.1344410e+000  1.1348631e-001  9.99e-001  1.136e+001    -0.3      88
```

36	7.1333225e+000	8.1538588e-002	9.99e-001	1.125e+001	0.0	85
37	7.1324351e+000	6.3874584e-002	9.99e-001	1.121e+001	0.0	85
38	7.1291213e+000	8.3467766e-002	9.99e-001	1.123e+001	0.0	85
39	7.1290554e+000	1.7605003e-001	9.99e-001	1.160e+001	-0.3	85
40	2.5722653e+000	3.6361673e+001	9.96e-001	8.115e+000	0.0	235
41	3.3175771e+000	2.5931182e+001	9.97e-001	1.378e+001	0.0	385
42	1.7733435e+000	1.8365155e+001	9.94e-001	3.181e+000	0.0	421
43	1.6246199e+000	6.4251825e+000	9.94e-001	1.909e+000	0.0	394
44	1.5821874e+000	6.9453657e+000	9.94e-001	1.862e+000	0.0	388
45	1.4624091e+000	1.2179255e+001	9.93e-001	2.417e+000	0.0	334
46	1.5643308e+000	3.5441078e+001	9.94e-001	3.955e+000	-0.3	326
47	1.4630958e+000	1.5350669e+001	9.93e-001	2.733e+000	0.0	340
48	1.3960200e+000	6.7972374e+000	9.93e-001	1.688e+000	0.0	322
49	1.3863289e+000	4.9138973e+000	9.93e-001	1.570e+000	0.0	320
50	1.3589583e+000	4.1861022e+000	9.93e-001	1.553e+000	0.0	303
51	1.3602675e+000	1.4921119e+001	9.93e-001	2.088e+000	-0.3	286
52	1.3619666e+000	1.5706961e+001	9.93e-001	2.597e+000	-0.3	293
53	1.3204174e+000	6.6013059e+000	9.92e-001	1.623e+000	0.0	282
54	1.3116436e+000	3.0804603e+000	9.92e-001	1.414e+000	0.0	280
55	1.3077322e+000	2.9130321e+000	9.92e-001	1.400e+000	0.0	276
56	1.2590537e+000	6.8096775e+000	9.92e-001	1.581e+000	-0.3	231
57	1.2323009e+000	5.2376581e+000	9.92e-001	1.612e+000	-0.3	237
58	1.2239367e+000	3.3723858e+000	9.92e-001	1.364e+000	0.0	231
59	1.2202149e+000	2.4031324e+000	9.92e-001	1.319e+000	0.0	229
60	1.2183535e+000	1.5835424e+000	9.92e-001	1.254e+000	0.0	229
61	1.2091838e+000	3.3812781e+000	9.92e-001	1.366e+000	0.0	221
62	1.2119490e+000	8.3769249e+000	9.92e-001	1.722e+000	-0.3	221
63	1.2091574e+000	6.3102335e+000	9.92e-001	1.575e+000	0.0	220
64	1.2030116e+000	1.9771772e+000	9.92e-001	1.252e+000	0.0	217
65	1.2020527e+000	1.6146306e+000	9.92e-001	1.222e+000	0.0	217
66	1.1985325e+000	1.3284980e+000	9.92e-001	1.199e+000	0.0	217
67	1.1670796e+000	1.1810175e+001	9.91e-001	1.927e+000	-0.3	187
68	1.1410268e+000	4.2171204e+000	9.91e-001	1.386e+000	-0.3	190
69	1.1367803e+000	5.0416206e+000	9.91e-001	1.439e+000	0.0	189
70	1.1318542e+000	1.4001742e+000	9.91e-001	1.159e+000	0.0	187
71	1.1310254e+000	1.5092381e+000	9.91e-001	1.168e+000	0.0	187
72	1.1294345e+000	1.0797685e+000	9.91e-001	1.133e+000	0.0	185
73	1.1277429e+000	6.5559052e+000	9.91e-001	1.548e+000	0.0	178
74	1.1187205e+000	1.3076148e+000	9.91e-001	1.129e+000	-0.3	179
75	1.1172080e+000	1.3091082e+000	9.91e-001	1.136e+000	0.0	179
76	1.1164888e+000	1.1368293e+000	9.91e-001	1.118e+000	0.0	179
77	1.1143308e+000	9.0817720e-001	9.91e-001	1.098e+000	0.0	177
78	1.1171032e+000	1.0236498e+001	9.91e-001	1.742e+000	0.0	164
79	1.1012588e+000	5.2519849e+000	9.91e-001	1.443e+000	-0.3	171
80	1.0947034e+000	4.1274771e+000	9.91e-001	1.326e+000	0.0	165
81	1.0921357e+000	1.5147953e+000	9.91e-001	1.134e+000	0.0	165
82	1.0916029e+000	1.1154621e+000	9.91e-001	1.103e+000	0.0	165
83	1.0896294e+000	1.1443211e+000	9.91e-001	1.093e+000	0.0	163
84	1.0889130e+000	1.9432410e+000	9.91e-001	1.157e+000	-0.3	162
85	1.0884142e+000	1.4859382e+000	9.91e-001	1.119e+000	0.0	162
86	1.0879479e+000	1.4386351e+000	9.91e-001	1.119e+000	0.0	162
87	1.0874698e+000	1.2994203e+000	9.91e-001	1.106e+000	0.0	162
88	1.0869454e+000	2.0865589e+000	9.91e-001	1.167e+000	0.0	162
89	1.0870173e+000	2.6366436e+000	9.91e-001	1.203e+000	0.0	162
90	1.0859193e+000	1.9394235e+000	9.91e-001	1.156e+000	0.0	162
91	1.0854713e+000	8.9908225e-001	9.91e-001	1.076e+000	0.0	162
92	1.0851325e+000	8.1534716e-001	9.91e-001	1.070e+000	0.0	162
93	1.0784985e+000	2.4398588e+000	9.91e-001	1.188e+000	0.0	157
94	1.0795372e+000	5.2044664e+000	9.91e-001	1.404e+000	-0.3	157
95	1.0773142e+000	1.6428661e+000	9.91e-001	1.132e+000	0.0	158
96	1.0763307e+000	1.0441938e+000	9.91e-001	1.087e+000	0.0	157
97	1.0760949e+000	7.2491641e-001	9.91e-001	1.063e+000	0.0	157
98	1.0743465e+000	1.1912289e+000	9.91e-001	1.095e+000	0.0	157
99	1.0762640e+000	6.6203512e+000	9.91e-001	1.505e+000	-0.3	157

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  100  1.0721646e+000  7.8446275e-001  9.91e-001  1.069e+000    -0.3     158

 ERROR EXIT -- Too many iterations

 Products with A     :     143        Total time   (secs) :     0.8
 Products with A'    :     101        Project time (secs) :     0.1
 Newton iterations   :       2        Mat-vec time (secs) :     0.5
 Line search its     :      72        Subspace iterations :       0


 ================================================================================
 PQNL1_SLIM v. 46  (Tue, 14 Jun 2011) based on v.1017
 ================================================================================
 No. rows              :     2001      No. columns           :     2001
 Initial tau           : 0.00e+000      Two-norm of b         : 2.35e+001
 Optimality tol        : 1.00e-004      Target objective      : -1.00e+000
 Basis pursuit tol     : 1.00e-006      Maximum iterations    :      100

     0  2.3532434e+001  0.0000000e+000  1.04e+000  6.104e+001     0.0       0

Inside of minConf_PQN
 Iteration   FunEvals Projections     Step Length          rNorm2        Opt Cond
         1          1           4    5.00000e-001    1.75924e+001    1.41865e+001
         2          1          35    1.00000e+000    9.46343e+000    1.84763e+001
         3          1          70    1.00000e+000    8.71212e+000    1.77062e+001
         4          1         105    1.00000e+000    7.82777e+000    1.76418e+001
         5          1         138    1.00000e+000    7.41473e+000    1.72725e+001
         6          1         167    1.00000e+000    7.21439e+000    1.44254e+001
         7          1         194    1.00000e+000    7.10486e+000    1.45202e+001
         8          1         230    1.00000e+000    7.01353e+000    1.45766e+001
         9          1         267    1.00000e+000    6.93408e+000    1.49268e+001
        10          1         303    1.00000e+000    6.86026e+000    1.38732e+001
        11          1         339    1.00000e+000    6.80540e+000    1.15724e+001
        12          1         375    1.00000e+000    6.77959e+000    1.03420e+001
        13          1         416    1.00000e+000    6.73767e+000    1.05924e+001
        14          1         454    1.00000e+000    6.71794e+000    9.84829e+000
        15          1         490    1.00000e+000    6.69478e+000    9.19379e+000
        16          1         522    1.00000e+000    6.67573e+000    9.17330e+000
        17          1         558    1.00000e+000    6.65871e+000    8.92338e+000
        18          1         600    1.00000e+000    6.64150e+000    9.70246e+000
        19          1         633    1.00000e+000    6.63182e+000    1.02743e+001
        20          1         669    1.00000e+000    6.61833e+000    1.00920e+001
        21          1         707    1.00000e+000    6.60702e+000    8.69914e+000
        22          1         741    1.00000e+000    6.60244e+000    7.03201e+000
        23          1         791    1.00000e+000    6.58912e+000    8.43013e+000
        24          1         840    1.00000e+000    6.58107e+000    9.04093e+000
        25          1         878    1.00000e+000    6.57419e+000    8.42861e+000
        26          1         916    1.00000e+000    6.56678e+000    7.68515e+000
        27          1         957    1.00000e+000    6.55796e+000    8.19470e+000
        28          1         984    1.00000e+000    6.55590e+000    7.70151e+000
        29          1        1052    1.00000e+000    6.54946e+000    7.37007e+000
        30          1        1087    1.00000e+000    6.54711e+000    7.03435e+000
        31          1        1147    1.00000e+000    6.53973e+000    8.52833e+000
        32          1        1216    1.00000e+000    6.53208e+000    1.01054e+001
        33          1        1269    1.00000e+000    6.52786e+000    9.69889e+000
        34          1        1324    1.00000e+000    6.52340e+000    9.49755e+000
        35          1        1410    1.00000e+000    6.51704e+000    7.06721e+000
        36          1        1441    1.00000e+000    6.51455e+000    6.83460e+000
        37          1        1472    1.00000e+000    6.51291e+000    5.72313e+000
        38          1        1499    1.00000e+000    6.51183e+000    5.27155e+000
        39          1        1537    1.00000e+000    6.51007e+000    5.33331e+000
        40          1        1587    1.00000e+000    6.50618e+000    7.34650e+000
        41          1        1635    1.00000e+000    6.50447e+000    8.05652e+000
        42          1        1774    1.00000e+000    6.49767e+000    1.20676e+001
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        43           1        1819    1.00000e+000    6.49605e+000    1.17135e+001
        44           1        1859    1.00000e+000    6.49016e+000    6.15718e+000
        45           1        1896    1.00000e+000    6.48827e+000    5.30665e+000
        46           1        1958    1.00000e+000    6.48663e+000    6.31416e+000
        47           1        2022    1.00000e+000    6.48318e+000    8.15862e+000
        48           1        2101    1.00000e+000    6.47899e+000    8.87512e+000
        49           1        2156    1.00000e+000    6.47734e+000    8.11285e+000
        50           1        2189    1.00000e+000    6.47453e+000    4.80242e+000
        51           1        2225    1.00000e+000    6.47364e+000    5.00169e+000
        52           1        2255    1.00000e+000    6.47293e+000    4.63207e+000
        53           1        2295    1.00000e+000    6.47190e+000    4.32141e+000
        54           1        2335    1.00000e+000    6.47113e+000    5.24619e+000
        55           1        2381    1.00000e+000    6.47003e+000    6.28763e+000
        56           1        2442    1.00000e+000    6.46859e+000    8.00972e+000
        57           1        2474    1.00000e+000    6.46816e+000    7.81203e+000
        58           1        2562    1.00000e+000    6.46677e+000    7.84007e+000
        59           1        2630    1.00000e+000    6.46622e+000    7.70938e+000
        60           1        2668    1.00000e+000    6.46541e+000    5.96494e+000
        61           1        2705    1.00000e+000    6.46476e+000    4.07712e+000
        62           1        2742    1.00000e+000    6.46433e+000    3.76749e+000
        63           1        2778    1.00000e+000    6.46391e+000    4.46267e+000
        64           1        2828    1.00000e+000    6.46301e+000    6.35322e+000
        65           1        2935    1.00000e+000    6.46227e+000    6.71326e+000
        66           1        2988    1.00000e+000    6.46080e+000    5.47075e+000
        67           1        3026    1.00000e+000    6.46005e+000    4.71005e+000
        68           1        3068    1.00000e+000    6.45965e+000    4.68235e+000
        69           1        3156    1.00000e+000    6.45789e+000    6.46057e+000
        70           1        3206    1.00000e+000    6.45697e+000    6.35852e+000
        71           1        3268    1.00000e+000    6.45536e+000    5.00572e+000
        72           1        3328    1.00000e+000    6.45454e+000    5.35024e+000
        73           1        3404    1.00000e+000    6.45338e+000    5.76805e+000
        74           1        3446    1.00000e+000    6.45268e+000    5.64023e+000
        75           1        3523    1.00000e+000    6.45033e+000    4.54264e+000
        76           1        3552    1.00000e+000    6.45016e+000    4.25152e+000
    76  6.4501564e+000  9.6913442e-002  1.16e+000  1.017e+001     0.0       62

Inside of minConf_PQN
 Iteration   FunEvals Projections     Step Length          rNorm2        Opt Cond
        77           1           4    5.00000e-001    5.43406e+000    2.46983e+001
        78           1          62    1.00000e+000    2.30638e+000    2.63067e+001
        79           1          91    1.00000e+000    1.84504e+000    2.51476e+001
        80           1         142    1.00000e+000    1.47016e+000    1.82613e+001
        81           1         183    1.00000e+000    1.25121e+000    1.52811e+001
        82           1         224    1.00000e+000    1.07074e+000    1.95288e+001
        83           1         267    1.00000e+000    9.85700e-001    1.27345e+001
        84           1         292    1.00000e+000    9.50418e-001    1.18843e+001
        85           1         331    1.00000e+000    9.15954e-001    1.08630e+001
        86           1         378    1.00000e+000    8.88894e-001    9.56285e+000
        87           1         431    1.00000e+000    8.60996e-001    7.66654e+000
        88           1         470    1.00000e+000    8.35265e-001    6.60137e+000
        89           1         505    1.00000e+000    8.15307e-001    7.29048e+000
        90           1         543    1.00000e+000    7.99889e-001    7.39546e+000
        91           1         591    1.00000e+000    7.83806e-001    6.30205e+000
        92           1         639    1.00000e+000    7.69363e-001    5.68274e+000
        93           1         697    1.00000e+000    7.59569e-001    5.86252e+000
        94           1         745    1.00000e+000    7.45155e-001    5.53766e+000
        95           1         793    1.00000e+000    7.32526e-001    5.18054e+000
        96           1         850    1.00000e+000    7.21701e-001    5.10412e+000
        97           1         870    1.00000e+000    7.14850e-001    6.47928e+000
        98           1         937    1.00000e+000    7.06391e-001    6.83446e+000
        99           1         993    1.00000e+000    6.96788e-001    4.66509e+000
       100           1        1059    1.00000e+000    6.88709e-001    5.97790e+000
```

```
ERROR EXIT -- Too many iterations

Products with A     :     105        Total time   (secs) :     8.7
Products with A'    :     105        Project time (secs) :     8.9
Newton iterations   :       2        Mat-vec time (secs) :     0.5
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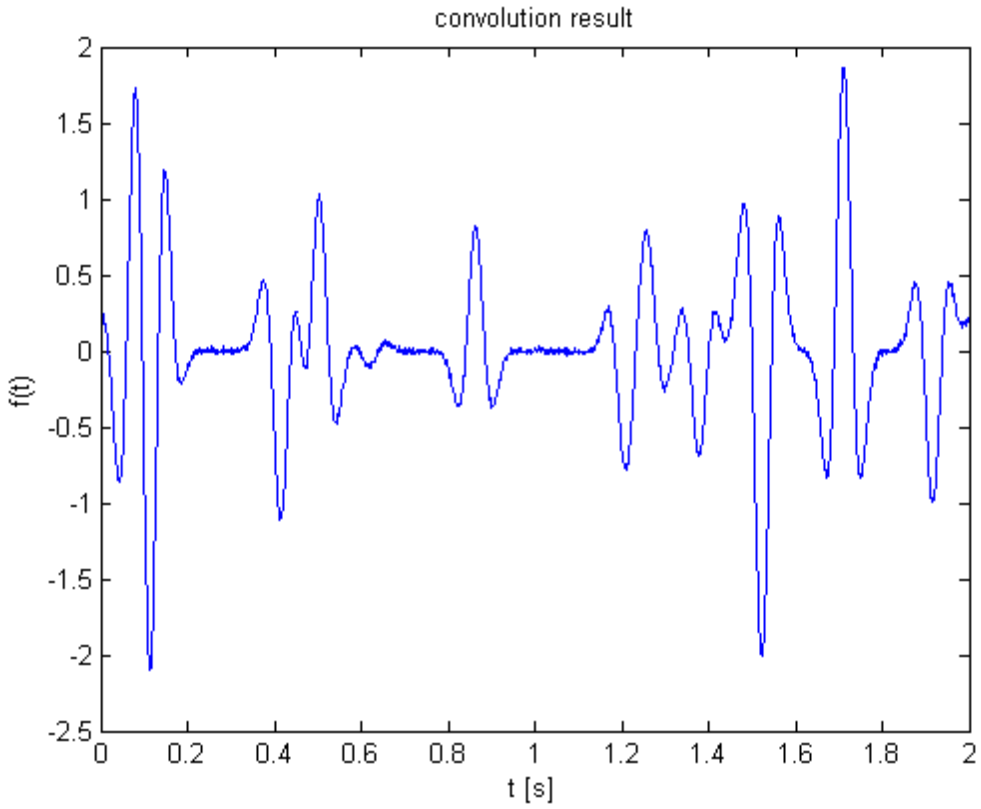

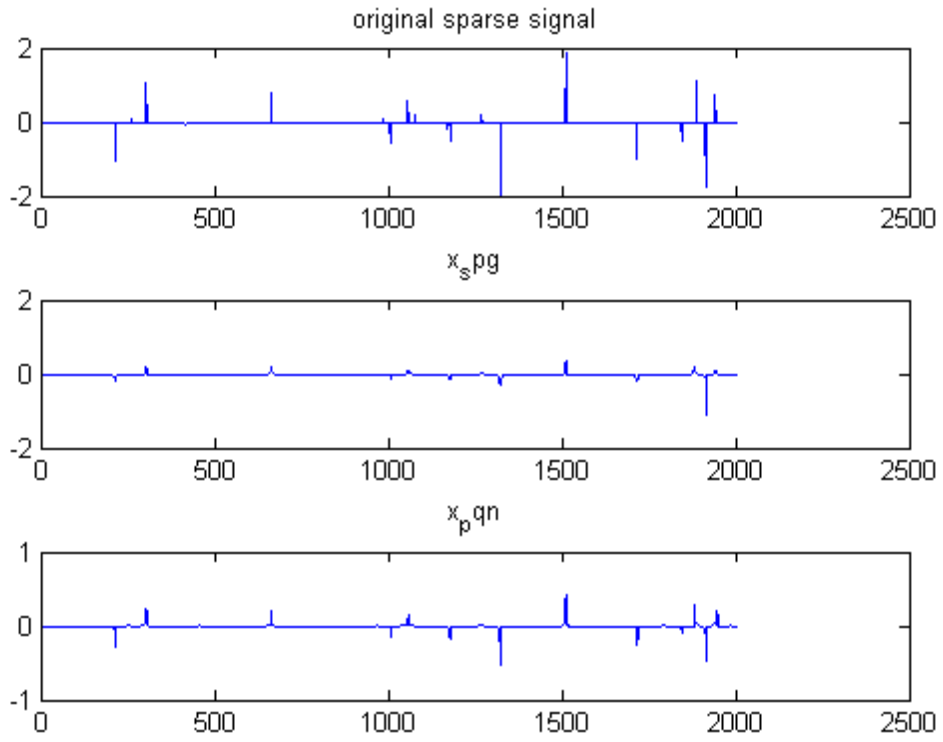
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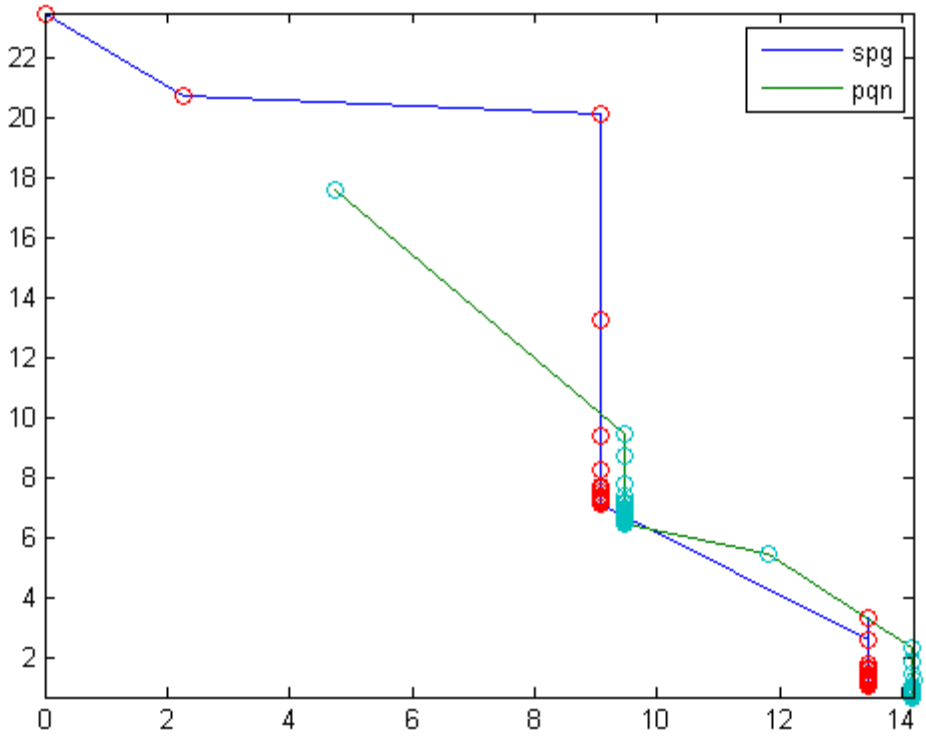
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