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```
% this experiment is to test whether pqnl1 can work for the expqnle given
% by help spgl1
```

addpath for PQN working

```
%addpath(genpath('/Volumes/Users/linamiao/Dropbox/PQN/'))
cd ../../../../pqnl1;
addpath(genpath(pwd))
cd ../experiments/help_spgl1/modifying/task10strictvssparse

%stream = RandStream.getGlobalStream;
%reset(stream);
```

sample matrix

```
m = 120; n = 512; k = 20; % m rows, n cols, k nonzeros.
A  = randn(m,n); %[Q,R] = qr(A',0);  A = Q';

opts.decTol = 1e-3;
opts.optTol = 1e-4;
opts.iterations = 100;
opts.nPrevVals = 1; % opt out the nonmonotone line search
%
% save temp A m n k opts
% clear;
% load temp
```

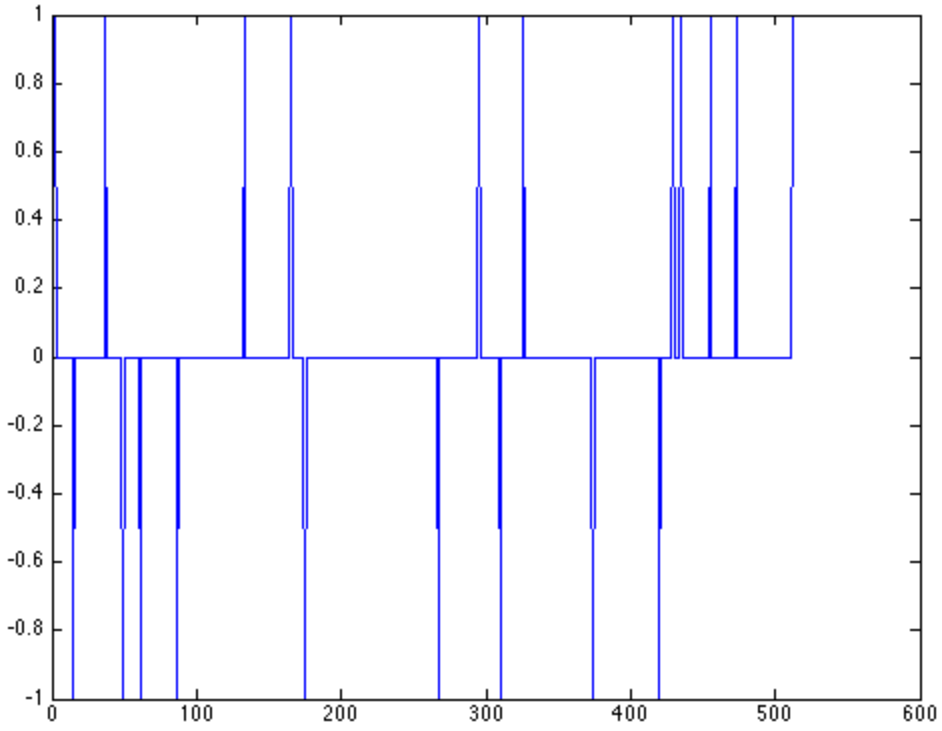
problem setting

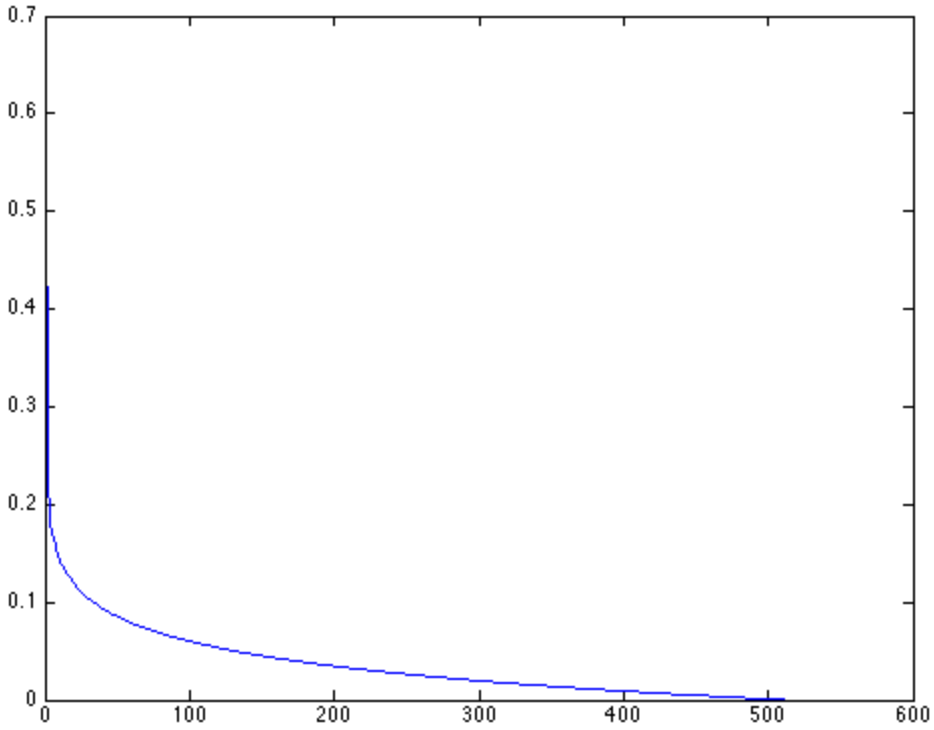
strict problem setting

```
p = randperm(n); x0 = zeros(n,1); x0(p(1:k)) = sign(randn(k,1));
figure;plot(x0)
b0  = A*x0 + 0.005 * randn(m,1);

% compressible problem setting
nn = linspace(0,1,n);
x0_compress = exp(-nn.^.1);
```

```
x0_compress = x0_compress - min(x0_compress);
figure;plot(x0_compress)
x0_compress = x0_compress(:);
b_compress  = A*x0_compress + 0.005 * randn(m,1);
```





reconstruct

```
[x_sparse,r_sparse,g_sparse,info_sparse] = pqnl1_2(A, b0, 0, 1e-3, zeros(size(A,2)
[x_compress,r_compress,g_compress,info_compress] = pqnl1_2(A, b_compress, 0, 1e-3,
figure('Name','pqn');
subplot(2,1,1);plot(x_sparse);subplot(2,1,2);plot(x_compress);


[x_spg1,r_spgl,g_spgl,info_spg1] = spgl1(A, b0, 0, 1e-3, zeros(size(A,2),1), opts)
[x_spg2,r_spg2,g_spg2,info_spg2] = spgl1(A, b_compress, 0, 1e-3, zeros(size(A,2),1
figure('Name','spg');
subplot(2,1,1);plot(x_spg1);subplot(2,1,2);plot(x_spg2);
```

```
================================================================================
PQNL1_SLIM v. 46  (Tue, 14 Jun 2011) based on v.1017
================================================================================
No. rows              :      120      No. columns           :      512
Initial tau           : 0.00e+00      Two-norm of b         : 4.45e+01
Optimality tol        : 1.00e-04      Target objective      : 1.00e-03
Basis pursuit tol     : 1.00e-06      Maximum iterations    :      100

    0  4.4476098e+01  0.0000000e+00   1.00e+00  1.676e+02     0.0       0
Iteration   FunEvals Projections     Step Length          rNorm2        O
        1          1           4     2.50000e-01     3.86092e+01     1.475
        2          1          45     1.00000e+00     2.33258e+01     2.278
```

```
         3           1          78     1.00000e+00     2.11808e+01     2.230
         4           1         111     1.00000e+00     1.90396e+01     2.216
         5           1         138     1.00000e+00     1.80243e+01     2.097
         6           1         167     1.00000e+00     1.73560e+01     1.897
         7           1         202     1.00000e+00     1.70250e+01     1.890
         8           1         237     1.00000e+00     1.67572e+01     2.014
         9           1         268     1.00000e+00     1.66084e+01     2.009
        10           1         303     1.00000e+00     1.64749e+01     1.844
        11           1         340     1.00000e+00     1.63905e+01     1.798
        12           1         369     1.00000e+00     1.63456e+01     1.698
        13           1         412     1.00000e+00     1.62937e+01     1.729
        14           1         443     1.00000e+00     1.62798e+01     1.655
        15           1         476     1.00000e+00     1.62519e+01     1.603
        16           1         505     1.00000e+00     1.62455e+01     1.467
    16  1.6245533e+01  2.1288502e-01   1.00e+00  3.406e+01     0.0      48
Iteration   FunEvals Projections     Step Length          rNorm2        O
        17           1           4     2.50000e-01     1.57805e+01     3.047
        18           1          45     1.00000e+00     7.36658e+00     3.266
        19           1          88     1.00000e+00     5.99313e+00     2.880
        20           1         119     1.00000e+00     5.32174e+00     2.593
        21           1         146     1.00000e+00     4.57442e+00     2.443
        22           1         185     1.00000e+00     4.13593e+00     2.639
        23           1         216     1.00000e+00     3.86015e+00     2.379
        24           1         253     1.00000e+00     3.63078e+00     2.347
        25           1         280     1.00000e+00     3.47544e+00     2.265
        26           1         311     1.00000e+00     3.33034e+00     2.433
        27           1         350     1.00000e+00     3.20852e+00     2.248
        28           1         389     1.00000e+00     3.06511e+00     1.881
        29           1         429     1.00000e+00     2.95783e+00     1.844
        30           1         467     1.00000e+00     2.86538e+00     1.836
        31           1         508     1.00000e+00     2.77046e+00     1.746
        32           1         590     1.00000e+00     2.63364e+00     2.099
        33           1         629     1.00000e+00     2.53301e+00     2.037
        34           1         694     1.00000e+00     2.34728e+00     1.855
        35           1         730     1.00000e+00     2.25430e+00     1.623
        36           1         772     1.00000e+00     2.14818e+00     1.498
        37           1         823     1.00000e+00     2.05336e+00     1.652
        38           1         906     1.00000e+00     1.97155e+00     1.936
        39           1         981     1.00000e+00     1.85477e+00     1.959
        40           1        1053     1.00000e+00     1.66231e+00     1.751
        41           1        1141     1.00000e+00     1.54466e+00     1.707
        42           1        1193     1.00000e+00     1.42415e+00     1.272
        43           1        1254     1.00000e+00     1.30025e+00     1.338
        44           1        1349     1.00000e+00     1.18569e+00     1.493
        45           1        1398     1.00000e+00     1.11994e+00     1.287
        46           1        1452     1.00000e+00     1.04353e+00     8.625
        47           1        1498     1.00000e+00     9.97955e-01     7.423
        48           1        1542     1.00000e+00     9.63577e-01     6.624
        49           1        1582     1.00000e+00     9.41202e-01     5.032
        50           1        1616     1.00000e+00     9.18444e-01     3.913
        51           1        1641     1.00000e+00     9.10887e-01     3.094
        52           1        1667     1.00000e+00     9.00780e-01     2.244
        53           1        1691     1.00000e+00     8.98051e-01     2.346
        54           1        1720     1.00000e+00     8.96563e-01     1.737
```

```
        55          1       1745     1.00000e+00     8.95580e-01     1.165
        56          1       1764     1.00000e+00     8.95369e-01     9.800
   56  8.9536859e-01  1.5123581e+00   8.94e-01  1.850e+00     0.0      42
Iteration   FunEvals Projections     Step Length          rNorm2        O
        57          1          4     1.25000e-01     8.42280e-01     1.381
        58          1         31     1.00000e+00     4.10656e-01     6.806
        59          1         63     1.00000e+00     3.28731e-01     2.869
        60          1         87     1.00000e+00     2.84161e-01     1.918
        61          1        113     1.00000e+00     2.43584e-01     1.761
        62          1        139     1.00000e+00     2.20857e-01     1.511
        63          1        165     1.00000e+00     2.04189e-01     1.361
        64          1        191     1.00000e+00     1.92247e-01     1.303
        65          1        217     1.00000e+00     1.81896e-01     1.306
        66          1        249     1.00000e+00     1.73217e-01     1.255
        67          1        280     1.00000e+00     1.66153e-01     1.224
        68          1        302     1.00000e+00     1.60553e-01     9.956
        69          1        324     1.00000e+00     1.56077e-01     9.480
        70          1        351     1.00000e+00     1.51039e-01     1.122
        71          1        382     1.00000e+00     1.47006e-01     1.224
        72          1        413     1.00000e+00     1.41575e-01     1.283
        73          1        436     1.00000e+00     1.35469e-01     1.184
        74          1        474     1.00000e+00     1.27176e-01     1.149
        75          1        520     1.00000e+00     1.21705e-01     1.110
        76          1        553     1.00000e+00     1.16690e-01     9.520
        77          1        591     1.00000e+00     1.10183e-01     9.628
        78          1        622     1.00000e+00     1.06646e-01     9.237
        79          1        658     1.00000e+00     1.01373e-01     9.914
        80          1        703     1.00000e+00     9.68388e-02     1.004
        81          1        758     1.00000e+00     9.09271e-02     9.096
        82          1        800     1.00000e+00     8.39740e-02     8.915
        83          1        858     1.00000e+00     7.82129e-02     7.697
        84          1        903     1.00000e+00     7.26768e-02     6.641
        85          1        961     1.00000e+00     6.74892e-02     6.308
        86          1       1014     1.00000e+00     6.32758e-02     5.812
        87          1       1046     1.00000e+00     6.09172e-02     5.711
        88          1       1075     1.00000e+00     5.86586e-02     4.692
        89          1       1100     1.00000e+00     5.72311e-02     3.679
        90          1       1135     1.00000e+00     5.59557e-02     3.187
        91          1       1150     1.00000e+00     5.48894e-02     2.303
        92          1       1170     1.00000e+00     5.42544e-02     1.987
        93          1       1188     1.00000e+00     5.36054e-02     1.450
        94          1       1207     1.00000e+00     5.32023e-02     1.438
        95          1       1235     1.00000e+00     5.23144e-02     2.011
        96          1       1246     1.00000e+00     5.21620e-02     1.734
        97          1       1261     1.00000e+00     5.17623e-02     1.326
        98          1       1272     1.00000e+00     5.16743e-02     1.119
        99          1       1280     1.00000e+00     5.15387e-02     1.436
       100          1       1299     1.00000e+00     5.13013e-02     8.756

ERROR EXIT -- Too many iterations

Products with A     :     111        Total time   (secs) :     4.2
Products with A'    :     111        Project time (secs) :     5.6
Newton iterations   :       3        Mat-vec time (secs) :     0.0
```

```
================================================================================
PQNL1_SLIM v. 46  (Tue, 14 Jun 2011) based on v.1017
================================================================================
No. rows              :      120      No. columns           :      512
Initial tau           : 0.00e+00      Two-norm of b         : 1.52e+01
Optimality tol        : 1.00e-04      Target objective      : 1.00e-03
Basis pursuit tol     : 1.00e-06      Maximum iterations    :      100

    0  1.5189344e+01  0.0000000e+00   1.00e+00  7.541e+01     0.0       0
Iteration   FunEvals Projections     Step Length          rNorm2        O
        1          1           4     2.50000e-01     1.34516e+01     3.824
        2          1          37     1.00000e+00     8.67948e+00     5.952
        3          1          70     1.00000e+00     8.33296e+00     5.792
        4          1          97     1.00000e+00     7.99112e+00     5.646
        5          1         124     1.00000e+00     7.87192e+00     5.426
        6          1         151     1.00000e+00     7.79233e+00     5.393
        7          1         178     1.00000e+00     7.74872e+00     5.015
        8          1         203     1.00000e+00     7.72592e+00     4.880
        9          1         230     1.00000e+00     7.71649e+00     4.787
       10          1         257     1.00000e+00     7.71091e+00     4.312
       11          1         288     1.00000e+00     7.70619e+00     4.009
       12          1         319     1.00000e+00     7.70494e+00     3.788
   12  7.7049365e+00  6.2951864e-02   1.00e+00  1.542e+01     0.0      46
Iteration   FunEvals Projections     Step Length          rNorm2        O
       13          1           4     2.50000e-01     6.82534e+00     1.071
       14          1          47     1.00000e+00     3.12232e+00     1.313
       15          1          80     1.00000e+00     2.53400e+00     1.222
       16          1         107     1.00000e+00     2.21084e+00     1.135
       17          1         134     1.00000e+00     1.99312e+00     1.084
       18          1         161     1.00000e+00     1.86950e+00     1.088
       19          1         188     1.00000e+00     1.76288e+00     1.056
       20          1         217     1.00000e+00     1.70093e+00     9.813
       21          1         246     1.00000e+00     1.65844e+00     9.534
       22          1         274     1.00000e+00     1.62057e+00     8.817
       23          1         316     1.00000e+00     1.58621e+00     9.442
       24          1         348     1.00000e+00     1.55616e+00     9.276
       25          1         377     1.00000e+00     1.52988e+00     8.517
       26          1         406     1.00000e+00     1.50889e+00     7.962
       27          1         435     1.00000e+00     1.49314e+00     8.414
       28          1         466     1.00000e+00     1.47714e+00     8.480
       29          1         496     1.00000e+00     1.46553e+00     8.902
       30          1         526     1.00000e+00     1.45726e+00     7.903
       31          1         576     1.00000e+00     1.44543e+00     7.645
       32          1         619     1.00000e+00     1.43882e+00     7.355
       33          1         652     1.00000e+00     1.43058e+00     6.071
       34          1         684     1.00000e+00     1.42418e+00     5.678
       35          1         711     1.00000e+00     1.42089e+00     5.699
       36          1         737     1.00000e+00     1.41620e+00     6.491
       37          1         769     1.00000e+00     1.41232e+00     6.925
       38          1         801     1.00000e+00     1.40814e+00     6.377
       39          1         843     1.00000e+00     1.40338e+00     5.354
       40          1         872     1.00000e+00     1.40094e+00     4.958
```

```
        41          1         903     1.00000e+00     1.39854e+00     4.915
        42          1         935     1.00000e+00     1.39600e+00     5.287
        43          1         965     1.00000e+00     1.39389e+00     4.838
        44          1        1009     1.00000e+00     1.39189e+00     4.473
        45          1        1043     1.00000e+00     1.39055e+00     4.120
        46          1        1070     1.00000e+00     1.38961e+00     3.707
        47          1        1100     1.00000e+00     1.38857e+00     3.299
        48          1        1125     1.00000e+00     1.38811e+00     2.996
   48  1.3881053e+00  6.6285238e-01   9.99e-01  2.103e+00     0.0     111
Iteration   FunEvals Projections     Step Length          rNorm2        O
        49          1           4     1.25000e-01     1.30250e+00     1.073
        50          1          25     1.00000e+00     5.83321e-01     1.444
        51          1          57     1.00000e+00     4.08492e-01     1.107
        52          1          83     1.00000e+00     3.53387e-01     6.963
        53          1         109     1.00000e+00     3.11981e-01     5.997
        54          1         131     1.00000e+00     2.74258e-01     5.929
        55          1         159     1.00000e+00     2.49450e-01     5.645
        56          1         187     1.00000e+00     2.29897e-01     4.983
        57          1         213     1.00000e+00     2.15561e-01     4.744
        58          1         245     1.00000e+00     2.03399e-01     4.299
        59          1         277     1.00000e+00     1.92553e-01     4.244
        60          1         303     1.00000e+00     1.83180e-01     3.614
        61          1         335     1.00000e+00     1.74783e-01     3.251
        62          1         369     1.00000e+00     1.66529e-01     3.442
        63          1         390     1.00000e+00     1.61463e-01     3.141
        64          1         422     1.00000e+00     1.55129e-01     2.943
        65          1         443     1.00000e+00     1.51553e-01     2.657
        66          1         477     1.00000e+00     1.47073e-01     2.624
        67          1         512     1.00000e+00     1.43509e-01     2.656
        68          1         534     1.00000e+00     1.41191e-01     2.308
        69          1         557     1.00000e+00     1.38406e-01     1.975
        70          1         591     1.00000e+00     1.35943e-01     2.077
        71          1         622     1.00000e+00     1.32930e-01     2.546
        72          1         654     1.00000e+00     1.30702e-01     2.293
        73          1         689     1.00000e+00     1.27288e-01     1.911
        74          1         712     1.00000e+00     1.25324e-01     1.886
        75          1         756     1.00000e+00     1.23332e-01     2.037
        76          1         783     1.00000e+00     1.21918e-01     2.236
        77          1         813     1.00000e+00     1.20582e-01     1.988
        78          1         855     1.00000e+00     1.18191e-01     1.726
        79          1         876     1.00000e+00     1.17254e-01     1.489
        80          1         902     1.00000e+00     1.15602e-01     1.319
        81          1         931     1.00000e+00     1.14572e-01     1.463
        82          1         974     1.00000e+00     1.13216e-01     1.596
        83          1         996     1.00000e+00     1.12455e-01     1.337
        84          1        1033     1.00000e+00     1.10846e-01     1.486
        85          1        1054     1.00000e+00     1.10337e-01     1.301
        86          1        1072     1.00000e+00     1.09340e-01     1.293
        87          1        1093     1.00000e+00     1.08761e-01     9.933
        88          1        1116     1.00000e+00     1.08250e-01     7.887
        89          1        1134     1.00000e+00     1.07941e-01     8.071
        90          1        1154     1.00000e+00     1.07575e-01     6.844
        91          1        1185     1.00000e+00     1.06993e-01     8.311
        92          1        1196     1.00000e+00     1.06844e-01     6.800
```

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       93          1       1204     1.00000e+00     1.06611e-01     8.441
       94          1       1220     1.00000e+00     1.06379e-01     5.192
       95          1       1236     1.00000e+00     1.06260e-01     6.212
       96          1       1245     1.00000e+00     1.06203e-01     5.235
       97          1       1259     1.00000e+00     1.05979e-01     4.658
       98          1       1276     1.00000e+00     1.05708e-01     6.391
       99          1       1293     1.00000e+00     1.05546e-01     7.886
      100          1       1302     1.00000e+00     1.05479e-01     6.165

ERROR EXIT -- Too many iterations

Products with A     :     111        Total time   (secs) :     2.7
Products with A'    :     111        Project time (secs) :     3.6
Newton iterations   :       3        Mat-vec time (secs) :     0.0


================================================================================
SPGL1_SLIM v. 46  (Tue, 14 Jun 2011) based on v.1017
================================================================================
No. rows              :      120      No. columns           :      512
Initial tau           : 0.00e+00      Two-norm of b         : 4.45e+01
Optimality tol        : 1.00e-04      Target objective      : 1.00e-03
Basis pursuit tol     : 1.00e-06      Maximum iterations    :      100

 Iter      Objective   Relative Gap  Rel Error      gNorm   stepG    nnzX
    0  4.4476098e+01  0.0000000e+00   1.00e+00  1.676e+02     0.0       0
    1  4.2370588e+01  2.0304975e+00   1.00e+00  1.490e+02    -0.3       1
    2  2.1597035e+01  3.2168129e+00   1.00e+00  8.114e+01     0.0      69
    3  1.9155922e+01  1.2768353e+00   1.00e+00  5.480e+01     0.0     129
    4  1.7935930e+01  1.0564923e+00   1.00e+00  4.584e+01     0.0     103
    5  1.7551997e+01  7.8168204e-01   1.00e+00  4.267e+01     0.0      96
    6  1.6998454e+01  6.3734460e-01   1.00e+00  4.006e+01     0.0      75
    7  1.6501886e+01  8.4313230e-01   1.00e+00  4.130e+01     0.0      48
    8  1.6395595e+01  4.4889225e-01   1.00e+00  3.671e+01    -0.3      53
    9  1.6353557e+01  2.4623548e-01   1.00e+00  3.459e+01     0.0      51
   10  1.6321933e+01  2.2529394e-01   1.00e+00  3.414e+01     0.0      51
   11  1.6299294e+01  3.6028617e-01   1.00e+00  3.588e+01     0.0      50
   12  1.6283830e+01  2.9897655e-01   1.00e+00  3.490e+01     0.0      49
   13  1.6265318e+01  1.6709270e-01   1.00e+00  3.367e+01     0.0      50
   14  1.6257938e+01  9.6601809e-02   1.00e+00  3.282e+01     0.0      48
   15  8.8768316e+00  1.6989692e+01   1.00e+00  2.971e+01     0.0     145
   16  6.9330724e+00  1.2522374e+01   1.00e+00  2.493e+01     0.0     329
   17  4.8531838e+00  1.3631672e+01   1.00e+00  1.308e+01     0.0     326
   18  4.4669516e+00  9.6029794e+00   1.00e+00  1.039e+01     0.0     296
   19  4.1670752e+00  8.6937964e+00   1.00e+00  9.223e+00     0.0     255
   20  3.5400599e+00  8.3272235e+00   1.00e+00  7.815e+00     0.0     186
   21  3.3795737e+00  7.6556814e+00   1.00e+00  6.858e+00    -0.3     198
   22  3.2805895e+00  8.4217179e+00   1.00e+00  6.988e+00     0.0     182
   23  3.1912656e+00  7.4535290e+00   1.00e+00  6.276e+00     0.0     175
   24  3.1493732e+00  1.2118554e+01   1.00e+00  7.752e+00     0.0     166
   25  3.1067649e+00  1.1404273e+01   1.00e+00  6.691e+00     0.0     166
   26  2.9910884e+00  8.0821326e+00   1.00e+00  6.215e+00     0.0     165
   27  2.9572529e+00  8.5496756e+00   1.00e+00  6.121e+00     0.0     161
   28  2.8999562e+00  8.0544885e+00   1.00e+00  5.948e+00     0.0     155
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29	2.7834921e+00	2.4569253e+01	1.00e+00	8.197e+00	0.0	130
30	2.5788671e+00	1.1782919e+01	1.00e+00	6.142e+00	-0.3	148
31	2.5253611e+00	9.7054387e+00	1.00e+00	5.415e+00	0.0	139
32	2.5040822e+00	8.4205255e+00	1.00e+00	5.193e+00	0.0	135
33	2.4588532e+00	6.6997848e+00	1.00e+00	4.738e+00	0.0	130
34	2.4196091e+00	1.5273322e+01	1.00e+00	6.126e+00	-0.3	128
35	2.3695237e+00	8.0206821e+00	1.00e+00	4.752e+00	-0.3	130
36	2.3546867e+00	7.0219249e+00	1.00e+00	4.626e+00	0.0	130
37	2.3280098e+00	6.8862703e+00	1.00e+00	4.498e+00	0.0	126
38	2.2734549e+00	1.7152482e+01	1.00e+00	5.887e+00	-0.3	125
39	2.2204705e+00	9.2578453e+00	1.00e+00	4.526e+00	-0.3	127
40	2.2038612e+00	6.7157497e+00	1.00e+00	4.251e+00	0.0	124
41	2.1890571e+00	7.2615888e+00	1.00e+00	4.256e+00	0.0	123
42	2.0967066e+00	1.5093140e+01	1.00e+00	5.052e+00	0.0	121
43	2.0625732e+00	1.0136669e+01	1.00e+00	4.275e+00	-0.3	122
44	2.0488130e+00	6.6978502e+00	1.00e+00	3.929e+00	0.0	121
45	2.0339014e+00	8.2434575e+00	1.00e+00	4.020e+00	0.0	121
46	1.9820987e+00	1.9817021e+01	9.99e-01	5.156e+00	0.0	122
47	1.9387809e+00	1.0426482e+01	9.99e-01	3.977e+00	-0.3	123
48	1.9260128e+00	6.8683529e+00	9.99e-01	3.674e+00	0.0	121
49	1.9140435e+00	7.9567620e+00	9.99e-01	3.729e+00	0.0	121
50	1.8093186e+00	1.8022460e+01	9.99e-01	4.421e+00	0.0	112
51	1.7880154e+00	1.4406750e+01	9.99e-01	3.906e+00	-0.3	113
52	1.7634918e+00	7.0391264e+00	9.99e-01	3.399e+00	0.0	116
53	1.7543064e+00	8.5449617e+00	9.99e-01	3.453e+00	0.0	113
54	1.7392489e+00	7.9568349e+00	9.99e-01	3.385e+00	0.0	114
55	1.7139870e+00	3.3303202e+01	9.99e-01	4.739e+00	0.0	108
56	1.6646988e+00	2.8925826e+01	9.99e-01	4.819e+00	-0.3	126
57	1.5960782e+00	1.0304215e+01	9.99e-01	3.179e+00	0.0	115
58	1.5870487e+00	8.3648875e+00	9.99e-01	3.069e+00	0.0	113
59	1.5758395e+00	8.8520569e+00	9.99e-01	3.070e+00	0.0	108
60	1.4741594e+00	1.1134771e+01	9.99e-01	2.991e+00	0.0	105
61	1.4576758e+00	1.5639584e+01	9.99e-01	3.201e+00	-0.3	109
62	1.4406931e+00	7.5015786e+00	9.99e-01	2.756e+00	-0.3	108
63	1.4320924e+00	7.9663084e+00	9.99e-01	2.728e+00	0.0	106
64	1.4191620e+00	8.0821546e+00	9.99e-01	2.723e+00	0.0	106
65	1.4077181e+00	2.0684282e+01	9.99e-01	3.240e+00	-0.3	107
66	1.3973767e+00	1.7099942e+01	9.99e-01	3.162e+00	-0.3	108
67	1.3846118e+00	8.8572844e+00	9.99e-01	2.669e+00	0.0	106
68	1.3786649e+00	8.5750006e+00	9.99e-01	2.664e+00	0.0	106
69	1.3583690e+00	8.7110507e+00	9.99e-01	2.621e+00	0.0	105
70	1.3426406e+00	2.2335130e+01	9.99e-01	3.359e+00	-0.3	106
71	1.3219977e+00	9.0838619e+00	9.99e-01	2.580e+00	-0.3	106
72	1.3162698e+00	8.0974290e+00	9.99e-01	2.544e+00	0.0	106
73	1.3016627e+00	8.1736251e+00	9.99e-01	2.513e+00	0.0	106
74	1.2690720e+00	2.6746948e+01	9.99e-01	3.469e+00	-0.3	107
75	1.2395561e+00	1.2905889e+01	9.99e-01	2.631e+00	-0.3	108
76	1.2310106e+00	6.8744228e+00	9.99e-01	2.363e+00	0.0	107
77	1.2245791e+00	7.2222378e+00	9.99e-01	2.358e+00	0.0	107
78	1.1755529e+00	1.3982188e+01	9.99e-01	2.648e+00	0.0	104
79	1.1681657e+00	1.6120926e+01	9.99e-01	2.655e+00	-0.3	106
80	1.1564820e+00	8.1277357e+00	9.99e-01	2.329e+00	0.0	106
81	1.1497275e+00	7.2605946e+00	9.99e-01	2.236e+00	0.0	105
82	1.1437994e+00	6.8606565e+00	9.99e-01	2.219e+00	0.0	105

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   83  1.1091840e+00  1.2666461e+01   9.99e-01  2.386e+00     0.0     105
   84  1.1000716e+00  8.8368362e+00   9.99e-01  2.279e+00    -0.3     105
   85  1.0925291e+00  6.7018351e+00   9.99e-01  2.113e+00     0.0     105
   86  1.0872165e+00  6.2795393e+00   9.99e-01  2.101e+00     0.0     104
   87  1.0704401e+00  7.1249572e+00   9.99e-01  2.084e+00     0.0     105
   88  1.0639921e+00  8.8374090e+00   9.99e-01  2.218e+00    -0.3     105
   89  1.0576367e+00  9.0580514e+00   9.99e-01  2.146e+00     0.0     104
   90  1.0501786e+00  5.6792170e+00   9.99e-01  2.027e+00     0.0     103
   91  1.0447066e+00  6.3419795e+00   9.99e-01  2.023e+00     0.0     103
   92  1.0371478e+00  5.7980585e+00   9.99e-01  2.005e+00     0.0     101
   93  1.0317038e+00  1.8861000e+01   9.99e-01  2.518e+00     0.0     100
   94  1.0070619e+00  4.8788565e+00   9.99e-01  1.914e+00    -0.3     103
   95  1.0028267e+00  5.7396677e+00   9.99e-01  1.934e+00     0.0     101
   96  9.9197092e-01  5.4801781e+00   9.91e-01  1.916e+00     0.0     100
   97  9.9045055e-01  2.9490460e+01   9.89e-01  2.904e+00    -0.3     101
   98  9.4433364e-01  5.7532345e+00   9.43e-01  1.886e+00    -0.3     108
   99  9.3583719e-01  5.1266264e+00   9.35e-01  1.796e+00     0.0     101
  100  9.3055587e-01  4.9811035e+00   9.30e-01  1.789e+00     0.0     101

ERROR EXIT -- Too many iterations

Products with A     :     147        Total time   (secs) :     0.3
Products with A'    :     101        Project time (secs) :     0.1
Newton iterations   :       2        Mat-vec time (secs) :     0.0
Line search its     :      65        Subspace iterations :       0


================================================================================
SPGL1_SLIM v. 46  (Tue, 14 Jun 2011) based on v.1017
================================================================================
No. rows              :      120      No. columns           :      512
Initial tau           : 0.00e+00      Two-norm of b         : 1.52e+01
Optimality tol        : 1.00e-04      Target objective      : 1.00e-03
Basis pursuit tol     : 1.00e-06      Maximum iterations    :      100

 Iter      Objective   Relative Gap  Rel Error      gNorm   stepG    nnzX
    0  1.5189344e+01  0.0000000e+00   1.00e+00  7.541e+01     0.0       0
    1  1.3451632e+01  1.5760419e+00   1.00e+00  4.402e+01    -0.3       1
    2  8.8648876e+00  1.4306529e+00   1.00e+00  2.674e+01     0.0      41
    3  8.0758850e+00  5.0410247e-01   1.00e+00  2.013e+01     0.0      94
    4  7.8594145e+00  3.6633886e-01   1.00e+00  1.800e+01     0.0      75
    5  7.8123724e+00  2.6663567e-01   1.00e+00  1.716e+01     0.0      66
    6  7.7575916e+00  1.6361190e-01   1.00e+00  1.605e+01     0.0      59
    7  7.7132573e+00  1.4784793e-01   1.00e+00  1.635e+01     0.0      50
    8  7.7076877e+00  6.3913192e-02   1.00e+00  1.535e+01    -0.3      51
    9  7.7052597e+00  4.1644204e-02   1.00e+00  1.516e+01     0.0      48
   10  3.7904714e+00  1.4424454e+01   1.00e+00  1.240e+01     0.0     169
   11  2.7053911e+00  7.6114582e+00   1.00e+00  7.626e+00     0.0     331
   12  2.1055871e+00  9.8242176e+00   1.00e+00  5.072e+00     0.0     285
   13  1.9723761e+00  6.3204628e+00   9.99e-01  3.947e+00     0.0     265
   14  1.8298366e+00  4.4850073e+00   9.99e-01  3.269e+00     0.0     240
   15  1.6539648e+00  6.2610021e+00   9.99e-01  3.508e+00     0.0     195
   16  1.6088529e+00  4.0742205e+00   9.99e-01  2.862e+00    -0.3     199
   17  1.5830662e+00  3.0331069e+00   9.99e-01  2.660e+00     0.0     195
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18	1.5607402e+00	3.2434184e+00	9.99e-01	2.617e+00	0.0	187
19	1.5430906e+00	6.7669597e+00	9.99e-01	3.261e+00	0.0	181
20	1.5188661e+00	3.2887904e+00	9.99e-01	2.564e+00	-0.3	176
21	1.5075096e+00	2.6884656e+00	9.99e-01	2.477e+00	0.0	175
22	1.4926075e+00	2.5055537e+00	9.99e-01	2.421e+00	0.0	172
23	1.4711084e+00	9.6275084e+00	9.99e-01	3.598e+00	0.0	153
24	1.4222454e+00	4.5491282e+00	9.99e-01	2.689e+00	-0.3	155
25	1.4137388e+00	1.7326748e+00	9.99e-01	2.255e+00	0.0	153
26	1.4075881e+00	2.1043048e+00	9.99e-01	2.281e+00	0.0	150
27	1.3899718e+00	3.0877552e+00	9.99e-01	2.424e+00	0.0	145
28	1.3840387e+00	2.2493824e+00	9.99e-01	2.278e+00	-0.3	145
29	1.3804759e+00	1.8134725e+00	9.99e-01	2.224e+00	0.0	143
30	1.3769012e+00	1.5995600e+00	9.99e-01	2.185e+00	0.0	141
31	1.3695629e+00	3.1601771e+00	9.99e-01	2.424e+00	0.0	139
32	1.3643322e+00	1.7734448e+00	9.99e-01	2.201e+00	-0.3	139
33	1.3621578e+00	1.5353599e+00	9.99e-01	2.170e+00	0.0	139
34	1.3577334e+00	1.4493236e+00	9.99e-01	2.150e+00	0.0	138
35	1.3564030e+00	8.7453049e+00	9.99e-01	3.215e+00	-0.3	131
36	1.3376898e+00	1.7836913e+00	9.99e-01	2.178e+00	-0.3	133
37	1.3353859e+00	1.3146598e+00	9.99e-01	2.114e+00	0.0	133
38	1.3339217e+00	1.1392475e+00	9.99e-01	2.084e+00	0.0	133
39	1.3225888e+00	1.6971180e+00	9.99e-01	2.154e+00	0.0	128
40	1.3216085e+00	3.4272198e+00	9.99e-01	2.386e+00	-0.3	130
41	1.3196761e+00	1.8175938e+00	9.99e-01	2.182e+00	0.0	127
42	1.3177534e+00	8.3962812e-01	9.99e-01	2.019e+00	0.0	127
43	1.3169483e+00	7.8724858e-01	9.99e-01	2.015e+00	0.0	127
44	1.3140549e+00	7.8506320e-01	9.99e-01	2.008e+00	0.0	127
45	1.3126994e+00	1.9838308e+00	9.99e-01	2.196e+00	-0.3	127
46	1.3120965e+00	2.5138427e+00	9.99e-01	2.237e+00	-0.3	127
47	5.7831112e-01	1.0831359e+01	5.77e-01	1.526e+00	0.0	270
48	4.4460842e-01	3.1822678e+00	4.44e-01	9.437e-01	0.0	269
49	3.9696192e-01	2.7775733e+00	3.96e-01	7.545e-01	0.0	255
50	3.7600775e-01	1.8580455e+00	3.75e-01	6.539e-01	0.0	247
51	3.4782607e-01	2.0232626e+00	3.47e-01	6.555e-01	0.0	226
52	3.3270332e-01	2.7005359e+00	3.32e-01	7.332e-01	-0.3	216
53	3.2094166e-01	2.7678393e+00	3.20e-01	7.390e-01	-0.3	211
54	3.1268584e-01	9.5479421e-01	3.12e-01	4.971e-01	0.0	205
55	3.0837912e-01	1.3977267e+00	3.07e-01	5.529e-01	0.0	201
56	2.9615011e-01	9.2073366e-01	2.95e-01	4.795e-01	0.0	195
57	2.9245117e-01	1.7563401e+00	2.91e-01	5.956e-01	-0.3	192
58	2.8974668e-01	1.8962437e+00	2.89e-01	5.962e-01	0.0	190
59	2.8512598e-01	1.4709773e+00	2.84e-01	5.481e-01	0.0	190
60	2.8238810e-01	6.8835102e-01	2.81e-01	4.425e-01	0.0	190
61	2.8007727e-01	7.2975821e-01	2.79e-01	4.471e-01	0.0	189
62	2.7012353e-01	1.4277519e+00	2.69e-01	5.240e-01	0.0	174
63	2.6960076e-01	1.8755949e+00	2.69e-01	5.934e-01	-0.3	176
64	2.6474110e-01	5.3514496e-01	2.64e-01	4.102e-01	0.0	175
65	2.6365627e-01	4.1773842e-01	2.63e-01	3.940e-01	0.0	175
66	2.6090224e-01	4.5691284e-01	2.60e-01	3.945e-01	0.0	173
67	2.5734221e-01	2.2421354e+00	2.56e-01	6.390e-01	-0.3	163
68	2.4920790e-01	8.7184501e-01	2.48e-01	4.464e-01	-0.3	163
69	2.4705069e-01	4.7114266e-01	2.46e-01	3.916e-01	0.0	162
70	2.4620923e-01	3.1081745e-01	2.45e-01	3.668e-01	0.0	161
71	2.4451532e-01	4.5239906e-01	2.44e-01	3.806e-01	0.0	161

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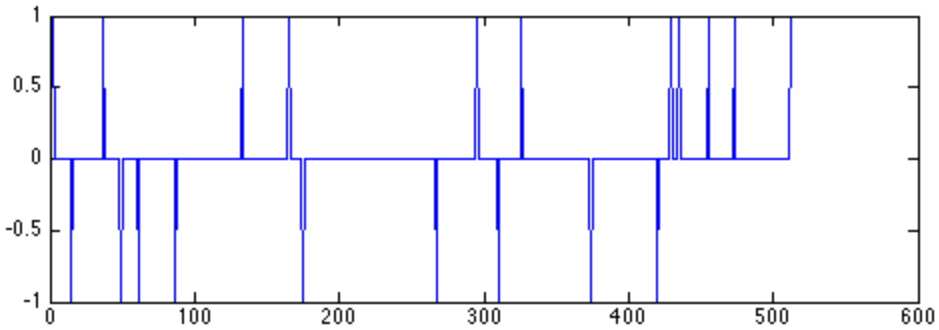
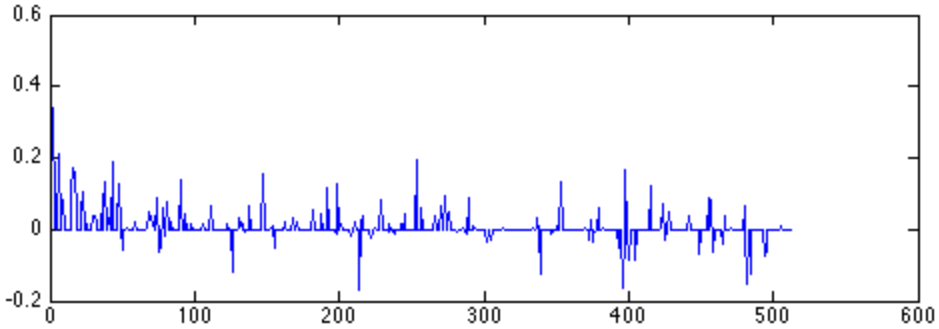
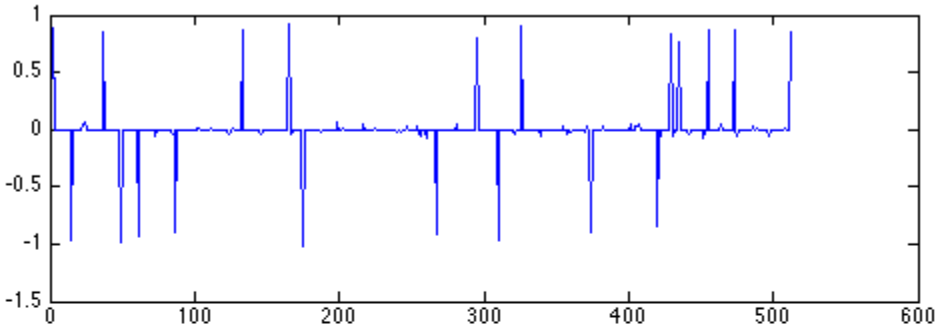
  72  2.4367486e-01  4.8311391e-01   2.43e-01  3.828e-01    -0.3     159
  73  2.4359508e-01  1.1814334e+00   2.43e-01  4.736e-01     0.0     160
  74  1.2307315e-01  2.3200058e+00   1.22e-01  3.549e-01     0.0     162
  75  1.0638622e-01  1.3683460e+00   1.05e-01  2.937e-01     0.0     165
  76  9.7924164e-02  8.0914809e-01   9.69e-02  2.030e-01     0.0     165
  77  9.4949640e-02  4.1645821e-01   9.39e-02  1.545e-01     0.0     165
  78  9.1816658e-02  3.7010449e-01   9.08e-02  1.489e-01     0.0     165
  79  8.7193796e-02  9.5089889e-01   8.62e-02  2.288e-01     0.0     166
  80  8.4155209e-02  2.8464364e-01   8.32e-02  1.412e-01    -0.3     166
  81  8.3266233e-02  2.7252914e-01   8.23e-02  1.371e-01     0.0     166
  82  8.2556204e-02  1.3555954e-01   8.16e-02  1.185e-01     0.0     165
  83  8.1306488e-02  4.8613617e-01   8.03e-02  1.609e-01     0.0     165
  84  8.0405068e-02  1.8182868e-01   7.94e-02  1.224e-01    -0.3     165
  85  8.0088587e-02  1.6503689e-01   7.91e-02  1.200e-01     0.0     165
  86  7.9567991e-02  1.5556655e-01   7.86e-02  1.186e-01     0.0     164
  87  7.9202671e-02  8.7373157e-01   7.82e-02  2.093e-01     0.0     163
  88  7.6051710e-02  1.9749510e-01   7.51e-02  1.226e-01    -0.3     163
  89  7.5651766e-02  1.2151999e-01   7.47e-02  1.122e-01     0.0     163
  90  7.5445464e-02  1.2435820e-01   7.44e-02  1.121e-01     0.0     163
  91  7.3287175e-02  2.3032023e-01   7.23e-02  1.228e-01     0.0     163
  92  7.3255085e-02  3.2869220e-01   7.23e-02  1.343e-01    -0.3     162
  93  3.7868173e-02  8.3329284e-01   3.69e-02  1.204e-01     0.0     164
  94  3.2151623e-02  4.3103538e-01   3.12e-02  8.754e-02     0.0     164
  95  2.8391589e-02  1.9994420e-01   2.74e-02  5.306e-02     0.0     164
  96  2.7462430e-02  1.4129065e-01   2.65e-02  4.570e-02     0.0     164
  97  2.6376915e-02  1.2629154e-01   2.54e-02  4.376e-02     0.0     164
  98  2.4541358e-02  2.7912980e-01   2.35e-02  6.584e-02     0.0     163
  99  2.3799713e-02  1.1225859e-01   2.28e-02  4.323e-02    -0.3     163
 100  2.3532156e-02  5.9476250e-02   2.25e-02  3.587e-02     0.0     163

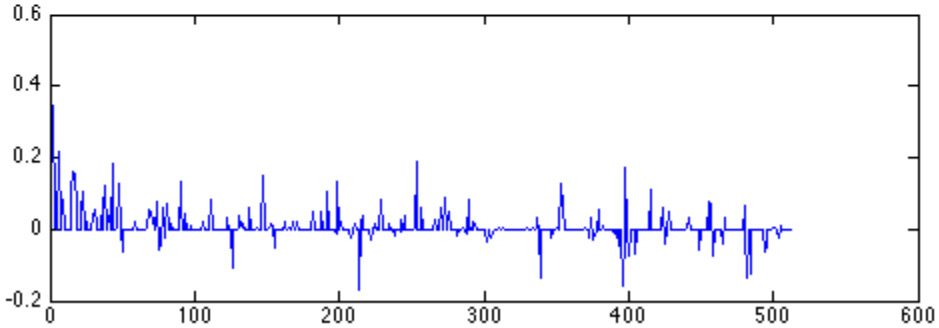
ERROR EXIT -- Too many iterations

Products with A     :     143        Total time   (secs) :     0.2
Products with A'    :     101        Project time (secs) :     0.1
Newton iterations   :       5        Mat-vec time (secs) :     0.0
Line search its     :      51        Subspace iterations :       0
```


1
0.5
0
-0.5
-1
0
100
200
300
400
500
600


0.6
0.4
0.2
0
-0.2
0
100
200
300
400
500
600


1
0.5
0
-0.5
-1
-1.5
0
100
200
300
400
500
600


0.6
0.4
0.2
0
-0.2
0
100
200
300
400
500
600

show result

```
info_sparse
info_spg1
info_compress
info_spg2

figure('Name','strict sparse Solution paths')
plot(info_sparse.xNorm1,info_sparse.rNorm2,info_spg1.xNorm1,info_spg1.rNorm2);hold
scatter(info_sparse.xNorm1,info_sparse.rNorm2);
scatter(info_spg1.xNorm1,info_spg1.rNorm2);hold off
legend('pqn','spg')
axis tight

figure('Name','compress signal Solution paths')
plot(info_compress.xNorm1,info_compress.rNorm2,info_spg2.xNorm1,info_spg2.rNorm2);
scatter(info_compress.xNorm1,info_compress.rNorm2);
scatter(info_spg2.xNorm1,info_spg2.rNorm2);hold off
legend('pqn','spg')
axis tight
```

```
info_sparse =

            tau: 19.9824
          rNorm: 0.0513
           rGap: 0.1046
          gNorm: 0.0914
           stat: 5
           iter: 100
         nProdA: 111
        nProdAt: 111
        nNewton: 3
    timeProject: 5.6171
    timeMatProd: 0.0498
        itnLSQR: 0
        options: [1x1 struct]
      timeTotal: 4.2137
          xNorm1: [100x1 double]
          rNorm2: [100x1 double]
          lambda: [100x1 double]


info_spg1 =

            tau: 19.8548
          rNorm: 0.9306
           rGap: 4.9811
          gNorm: 1.7886
           stat: 5
           iter: 100
         nProdA: 147
        nProdAt: 101
```

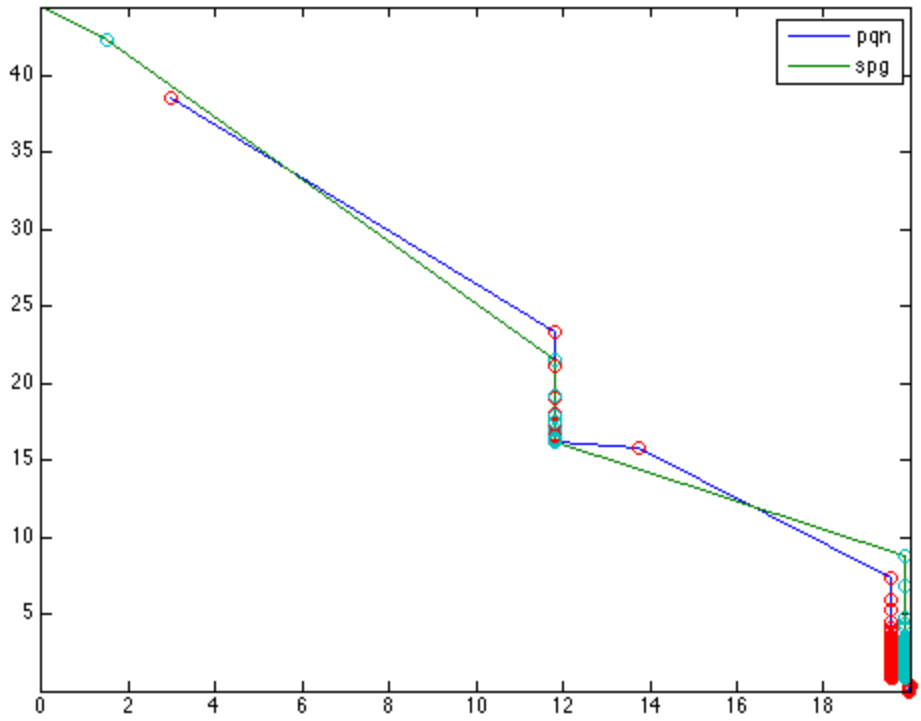
```
        nNewton: 2
    timeProject: 0.0720
    timeMatProd: 0.0207
        itnLSQR: 0
        options: [1x1 struct]
      timeTotal: 0.3052
          xNorm1: [100x1 double]
          rNorm2: [100x1 double]
          lambda: [100x1 double]

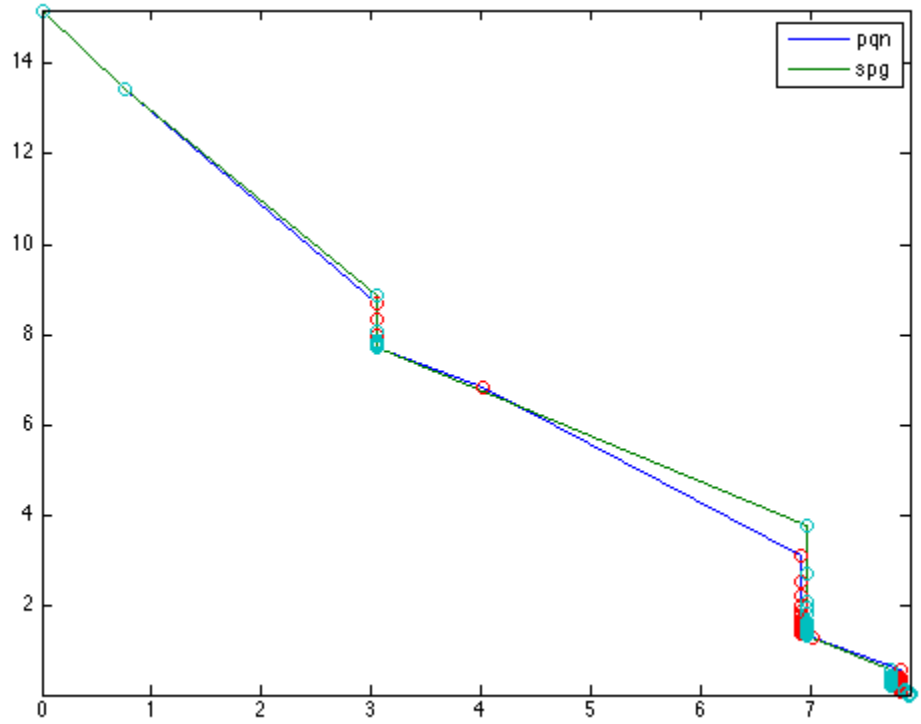

info_compress =

            tau: 7.8243
           rNorm: 0.1055
            rGap: 0.1135
           gNorm: 0.1573
            stat: 5
            iter: 100
          nProdA: 111
         nProdAt: 111
         nNewton: 3
    timeProject: 3.6109
    timeMatProd: 0.0269
        itnLSQR: 0
        options: [1x1 struct]
      timeTotal: 2.6566
          xNorm1: [100x1 double]
          rNorm2: [100x1 double]
          lambda: [100x1 double]


info_spg2 =

            tau: 7.9091
           rNorm: 0.0235
            rGap: 0.0595
           gNorm: 0.0359
            stat: 5
            iter: 100
          nProdA: 143
         nProdAt: 101
         nNewton: 5
    timeProject: 0.0660
    timeMatProd: 0.0209
        itnLSQR: 0
        options: [1x1 struct]
      timeTotal: 0.2381
          xNorm1: [100x1 double]
          rNorm2: [100x1 double]
          lambda: [100x1 double]
```


pqn
spg
40
35
30
25
20
15
10
5
0
2
4
6
8
10
12
14
16
18


pqn
spg
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7

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