

---

```

cd ../../../../pqn11
addpath(genpath(pwd))
cd ../experiments/help_spg11/modifying/task17mmv/
clear;

m = 50; n = 128; % Measurement matrix is m x n
k = 14; % Set sparsity level x0
A = randn(m,n); % Random encoding matrix
[Q,R] = qr(A',0); A = Q';

% group sparse X0
p = 2; nn = n/2;
X0 = zeros(nn,p);
pp = randperm(nn); pp = pp(1:k);
X0(pp,:) = 1e-3*randn(k,p);
B = A * vec(X0) + 0.005 * randn(m,1);
b = B(:);

groups = p;

options.project = @(x,weight,tau) NormL12_project(groups,x,weight,tau);
options.primal_norm = @(x,weight) NormL12_primal(groups,x,weight);
options.dual_norm = @(x,weight) NormL12_dual(groups,x,weight);

% cd ../task7
% addpath(genpath(pwd))
% cd ../task8
% tau = mixNorm(X0,1,2);

tau = 0;
sigma = 1e-3;
[x_spg,r_spg,g_spg,info_spg] = spg11(A,B(:),tau,sigma,zeros(size(A,2),1),options);
[x_pqn1,r_pqn1,g_pqn1,info_pqn1] = pqn1_2(A,B(:),tau,sigma,zeros(size(A,2),1),opt

figure;
subplot(3,1,1); plot(vec(X0));title('X0')
subplot(3,1,2); plot(vec(x_spg)); title('x_spg')
subplot(3,1,3); plot(vec(x_pqn1)); title('x_pqn')
title('Multiple Measurement Vector Basis Pursuit');
info_spg
info_pqn1

```

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```

=====
SPGL1_SLIM v. 46 (Tue, 14 Jun 2011) based on v.1017
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```

No. rows	:	50	No. columns	:	128
Initial tau	:	0.00e+00	Two-norm of b	:	3.78e-02
Optimality tol	:	1.00e-04	Target objective	:	1.00e-03
Basis pursuit tol	:	1.00e-06	Maximum iterations	:	500

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Iter	Objective	Relative Gap	Rel Error	gNorm	stepG	nnzX
0	3.7837286e-02	0.0000000e+00	3.68e-02	1.142e-02	0.0	0
1	3.7018887e-02	1.9178835e-03	3.60e-02	1.050e-02	-0.3	2
2	2.4811620e-02	1.1349219e-03	2.38e-02	1.029e-02	0.0	29
3	1.7501491e-02	3.4784980e-04	1.65e-02	4.672e-03	0.0	44
4	1.6109616e-02	7.7432176e-05	1.51e-02	3.006e-03	0.0	39
5	1.5942848e-02	6.4538172e-05	1.49e-02	2.861e-03	0.0	39
6	1.5675134e-02	3.8385538e-05	1.47e-02	2.669e-03	0.0	36
7	1.5653908e-02	8.8563419e-05	1.47e-02	3.153e-03	0.0	38
8	1.5803922e-02	1.9576987e-04	1.48e-02	3.777e-03	0.0	34
9	1.5502439e-02	2.3280673e-05	1.45e-02	2.615e-03	0.0	35
10	1.5477641e-02	1.0453473e-05	1.45e-02	2.480e-03	0.0	35
11	1.5473870e-02	8.8985610e-06	1.45e-02	2.471e-03	0.0	35
12	1.5467471e-02	3.7164004e-06	1.45e-02	2.429e-03	0.0	36
13	1.5465380e-02	8.5392620e-06	1.45e-02	2.478e-03	0.0	36
14	1.5466276e-02	1.5323373e-05	1.45e-02	2.518e-03	-0.3	35
15	1.5462919e-02	1.7574099e-06	1.45e-02	2.419e-03	0.0	36
16	1.5462667e-02	1.3363741e-06	1.45e-02	2.413e-03	0.0	36
17	2.5939185e-03	4.4815928e-05	1.59e-03	5.043e-04	0.0	67
18	2.3707348e-03	1.4732182e-05	1.37e-03	3.933e-04	0.0	68
19	2.2759705e-03	1.2012127e-05	1.28e-03	3.720e-04	0.0	68
20	2.1483731e-03	3.5659203e-05	1.15e-03	4.481e-04	0.0	65
21	2.2360964e-03	5.4967477e-05	1.24e-03	5.379e-04	-0.3	60
22	2.0124307e-03	1.5023042e-05	1.01e-03	3.540e-04	0.0	63
23	1.9711825e-03	6.5729312e-06	9.71e-04	3.113e-04	0.0	62
24	1.9616787e-03	5.7669250e-06	9.62e-04	3.063e-04	0.0	62
25	1.9049126e-03	1.4009385e-05	9.05e-04	3.323e-04	0.0	62
26	1.8904184e-03	7.5462552e-06	8.90e-04	3.075e-04	-0.3	62
27	1.8766098e-03	6.4370171e-06	8.77e-04	2.965e-04	0.0	62
28	1.8673076e-03	5.1875994e-06	8.67e-04	2.926e-04	0.0	61
29	1.8584736e-03	4.1929105e-06	8.58e-04	2.844e-04	0.0	61
30	1.8483747e-03	6.2215066e-06	8.48e-04	2.954e-04	0.0	59
31	1.8488053e-03	1.5956749e-05	8.49e-04	3.315e-04	0.0	61
32	1.8312540e-03	8.0702256e-06	8.31e-04	3.020e-04	0.0	59
33	1.8210719e-03	3.8731326e-06	8.21e-04	2.787e-04	0.0	60
34	1.8160653e-03	3.5669436e-06	8.16e-04	2.770e-04	0.0	59
35	1.7697630e-03	9.0953960e-06	7.70e-04	2.929e-04	0.0	59
36	1.7756678e-03	1.4316007e-05	7.76e-04	3.221e-04	-0.3	58
37	1.7501263e-03	5.3896837e-06	7.50e-04	2.751e-04	0.0	59
38	1.7434710e-03	2.6800886e-06	7.43e-04	2.639e-04	0.0	59
39	1.7410092e-03	2.5329733e-06	7.41e-04	2.627e-04	0.0	59
40	1.7271006e-03	4.2183228e-06	7.27e-04	2.713e-04	0.0	58
41	1.7246386e-03	4.2716223e-06	7.25e-04	2.688e-04	-0.3	58
42	1.7216669e-03	5.8024552e-06	7.22e-04	2.770e-04	0.0	58
43	1.7190241e-03	2.6546792e-06	7.19e-04	2.609e-04	0.0	58
44	1.7172383e-03	2.9957891e-06	7.17e-04	2.630e-04	0.0	58
45	1.7154846e-03	1.7306285e-06	7.15e-04	2.566e-04	0.0	58
46	1.7122827e-03	6.2177892e-06	7.12e-04	2.775e-04	0.0	58
47	1.7163767e-03	9.3831754e-06	7.16e-04	2.902e-04	-0.3	58
48	1.7076438e-03	4.2953881e-06	7.08e-04	2.678e-04	0.0	58
49	1.7063553e-03	1.7486946e-06	7.06e-04	2.556e-04	0.0	58
50	1.7051212e-03	1.9268590e-06	7.05e-04	2.563e-04	0.0	58
51	1.7015749e-03	8.2287849e-06	7.02e-04	2.847e-04	-0.3	56

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52	1.6933347e-03	5.9690496e-06	6.93e-04	2.727e-04	-0.3	56
53	1.6884183e-03	1.2250873e-06	6.88e-04	2.507e-04	0.0	56
54	1.6873970e-03	1.9059979e-06	6.87e-04	2.537e-04	0.0	56
55	1.6842637e-03	1.7398455e-06	6.84e-04	2.526e-04	0.0	56
56	1.6830251e-03	5.7111559e-06	6.83e-04	2.701e-04	-0.3	56
57	1.6839257e-03	4.7490521e-06	6.84e-04	2.667e-04	0.0	55
58	1.6801303e-03	4.5477660e-06	6.80e-04	2.647e-04	0.0	55
59	1.6790897e-03	1.2827283e-06	6.79e-04	2.496e-04	0.0	55
60	1.6782995e-03	1.6653903e-06	6.78e-04	2.512e-04	0.0	55
61	1.6795121e-03	1.0826415e-05	6.80e-04	2.899e-04	0.0	56
62	1.6646261e-03	1.0902646e-05	6.65e-04	2.908e-04	-0.3	54
63	1.6527776e-03	1.4330404e-06	6.53e-04	2.467e-04	0.0	56
64	1.6518668e-03	1.3360466e-06	6.52e-04	2.461e-04	0.0	55
65	1.6509688e-03	1.0805984e-06	6.51e-04	2.449e-04	0.0	55
66	1.6492726e-03	3.5767570e-06	6.49e-04	2.561e-04	0.0	55
67	1.6486612e-03	1.1615279e-06	6.49e-04	2.449e-04	-0.3	55
68	1.6481957e-03	1.4616451e-06	6.48e-04	2.462e-04	0.0	55
69	1.6477634e-03	9.8584250e-07	6.48e-04	2.439e-04	0.0	54
70	1.6467220e-03	3.9270586e-06	6.47e-04	2.575e-04	0.0	54
71	1.6460054e-03	1.0829419e-06	6.46e-04	2.441e-04	-0.3	54
72	1.6456655e-03	1.0924810e-06	6.46e-04	2.441e-04	0.0	54
73	1.6451403e-03	9.4326335e-07	6.45e-04	2.434e-04	0.0	54
74	1.6436892e-03	6.0075957e-06	6.44e-04	2.669e-04	-0.3	54
75	1.6435166e-03	3.5445224e-06	6.44e-04	2.546e-04	-0.3	54
76	1.6416184e-03	9.9039495e-07	6.42e-04	2.431e-04	0.0	54
77	1.6414266e-03	8.0534945e-07	6.41e-04	2.422e-04	0.0	54
78	1.6403419e-03	8.1912367e-07	6.40e-04	2.422e-04	0.0	54
79	1.6414357e-03	5.6353466e-06	6.41e-04	2.641e-04	-0.3	53
80	1.6376547e-03	2.4002043e-06	6.38e-04	2.490e-04	-0.3	53
81	1.6366720e-03	8.1684652e-07	6.37e-04	2.416e-04	0.0	53
82	1.6364142e-03	7.6157836e-07	6.36e-04	2.413e-04	0.0	53
83	1.6358235e-03	9.0153592e-07	6.36e-04	2.419e-04	0.0	53
84	1.6360899e-03	5.7831971e-06	6.36e-04	2.644e-04	-0.3	53
85	1.6345046e-03	6.9754544e-07	6.35e-04	2.407e-04	-0.3	53
86	1.6343186e-03	6.4805763e-07	6.34e-04	2.404e-04	0.0	53
87	1.6332210e-03	8.0589517e-07	6.33e-04	2.410e-04	0.0	53
88	1.6333558e-03	3.6177741e-06	6.33e-04	2.544e-04	-0.3	53
89	1.6320901e-03	8.3141926e-07	6.32e-04	2.411e-04	-0.3	53
90	1.6317263e-03	5.6712188e-07	6.32e-04	2.397e-04	0.0	53
91	1.6315267e-03	7.2678234e-07	6.32e-04	2.404e-04	0.0	53
92	1.6311822e-03	1.2745868e-06	6.31e-04	2.430e-04	0.0	53
93	1.6309938e-03	9.3792386e-07	6.31e-04	2.415e-04	-0.3	53
94	1.6308734e-03	5.7348953e-07	6.31e-04	2.397e-04	0.0	53
95	1.6307128e-03	7.7217614e-07	6.31e-04	2.406e-04	0.0	53
96	1.6306459e-03	2.6923927e-06	6.31e-04	2.491e-04	0.0	53
97	1.6300241e-03	7.2157153e-07	6.30e-04	2.404e-04	-0.3	53
98	1.6299377e-03	5.4125855e-07	6.30e-04	2.394e-04	0.0	53
99	1.6297114e-03	5.8792374e-07	6.30e-04	2.396e-04	0.0	53
100	1.6297137e-03	2.5180305e-06	6.30e-04	2.487e-04	-0.3	53
101	1.2506414e-03	4.9839055e-05	2.51e-04	3.643e-04	0.0	53
102	1.0439987e-03	5.1210353e-06	4.40e-05	1.711e-04	0.0	53

EXIT -- Found a root

---

Products with A	:	146	Total time (secs)	:	0.8
Products with A'	:	103	Project time (secs)	:	0.1
Newton iterations	:	3	Mat-vec time (secs)	:	0.3
Line search its	:	55	Subspace iterations	:	0

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PQNL1\_SLIM v. 46 (Tue, 14 Jun 2011) based on v.1017

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No. rows	:	50	No. columns	:	128
Initial tau	:	0.00e+00	Two-norm of b	:	3.78e-02
Optimality tol	:	1.00e-04	Target objective	:	1.00e-03
Basis pursuit tol	:	1.00e-06	Maximum iterations	:	500

0	3.7837286e-02	0.0000000e+00	3.68e-02	1.142e-02	0.0	0
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Inside of minConf\_PQN

Iteration	FunEvals	Projections	Step Length	rNorm2	O
1	1	4	1.00000e+00	1.76290e-02	2.992
2	1	10	1.00000e+00	1.65187e-02	1.649
3	1	19	1.00000e+00	1.59213e-02	8.579
4	1	29	1.00000e+00	1.57007e-02	6.451
5	1	39	1.00000e+00	1.56062e-02	4.370
6	1	49	1.00000e+00	1.55363e-02	2.632
7	1	61	1.00000e+00	1.55127e-02	2.147
8	1	77	1.00000e+00	1.54942e-02	1.959
9	1	94	1.00000e+00	1.54835e-02	1.561
10	1	107	1.00000e+00	1.54746e-02	1.279
11	1	126	1.00000e+00	1.54677e-02	9.937

break of testUpdateTau, exit minConf\_PQN

11	1.5467745e-02	1.2066222e-05	1.45e-02	2.510e-03	0.0	37
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Inside of minConf\_PQN

Iteration	FunEvals	Projections	Step Length	rNorm2	O
12	1	4	1.00000e+00	3.17844e-03	6.253
13	1	9	1.00000e+00	2.99858e-03	4.802
14	1	17	1.00000e+00	2.74327e-03	3.054
15	1	28	1.00000e+00	2.65400e-03	2.562
16	1	39	1.00000e+00	2.57063e-03	2.163
17	1	54	1.00000e+00	2.51343e-03	1.892
18	1	72	1.00000e+00	2.47165e-03	1.645
19	1	89	1.00000e+00	2.43966e-03	1.595
20	1	106	1.00000e+00	2.40248e-03	1.774
21	1	131	1.00000e+00	2.36620e-03	1.783
22	1	146	1.00000e+00	2.33126e-03	1.491
23	1	164	1.00000e+00	2.29407e-03	1.175
24	1	183	1.00000e+00	2.27366e-03	1.104
25	1	200	1.00000e+00	2.25557e-03	1.003
26	1	215	1.00000e+00	2.24585e-03	7.778
27	1	234	1.00000e+00	2.23614e-03	7.311
28	1	243	1.00000e+00	2.23177e-03	7.534
29	1	267	1.00000e+00	2.22290e-03	8.144
30	1	288	1.00000e+00	2.21359e-03	8.496
31	1	318	1.00000e+00	2.20097e-03	8.576

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32      1      354      1.00000e+00      2.18997e-03      7.833
33      1      374      1.00000e+00      2.18177e-03      6.693
34      1      400      1.00000e+00      2.17446e-03      5.891
35      1      437      1.00000e+00      2.16739e-03      5.202
36      1      459      1.00000e+00      2.16248e-03      4.318
37      1      491      1.00000e+00      2.15809e-03      4.383
38      1      519      1.00000e+00      2.15465e-03      4.216
39      1      547      1.00000e+00      2.14986e-03      4.466
40      1      563      1.00000e+00      2.14706e-03      3.889
41      1      581      1.00000e+00      2.14476e-03      3.351
42      1      598      1.00000e+00      2.14322e-03      2.989
43      1      618      1.00000e+00      2.14208e-03      2.478
44      1      638      1.00000e+00      2.14110e-03      2.042
break of testUpdateTau, exit minConf_PQN
44  2.1410984e-03  1.9891529e-06  1.14e-03  3.214e-04  0.0  53

Inside of minConf_PQN
Iteration  FunEvals Projections      Step Length      rNorm2      0
45          1          4      1.00000e+00      1.08401e-03      9.797
find BP solution

EXIT -- Found a root

Products with A      :      49      Total time (secs) :      4.6
Products with A'     :      49      Project time (secs) :      4.5
Newton iterations    :      3      Mat-vec time (secs) :      0.2

info_spg =

      tau: 0.2189
      rNorm: 0.0010
      rGap: 5.1210e-06
      gNorm: 1.7106e-04
      stat: 1
      iter: 102
      nProdA: 146
      nProdAt: 103
      nNewton: 3
      timeProject: 0.0805
      timeMatProd: 0.3076
      itnLSQR: 0
      options: [1x1 struct]
      timeTotal: 0.7529
      xNorm1: [102x1 double]
      rNorm2: [102x1 double]
      lambda: [102x1 double]

info_pqn1 =

      tau: 0.2188
      rNorm: 0.0011
      rGap: 4.2664e-06

```

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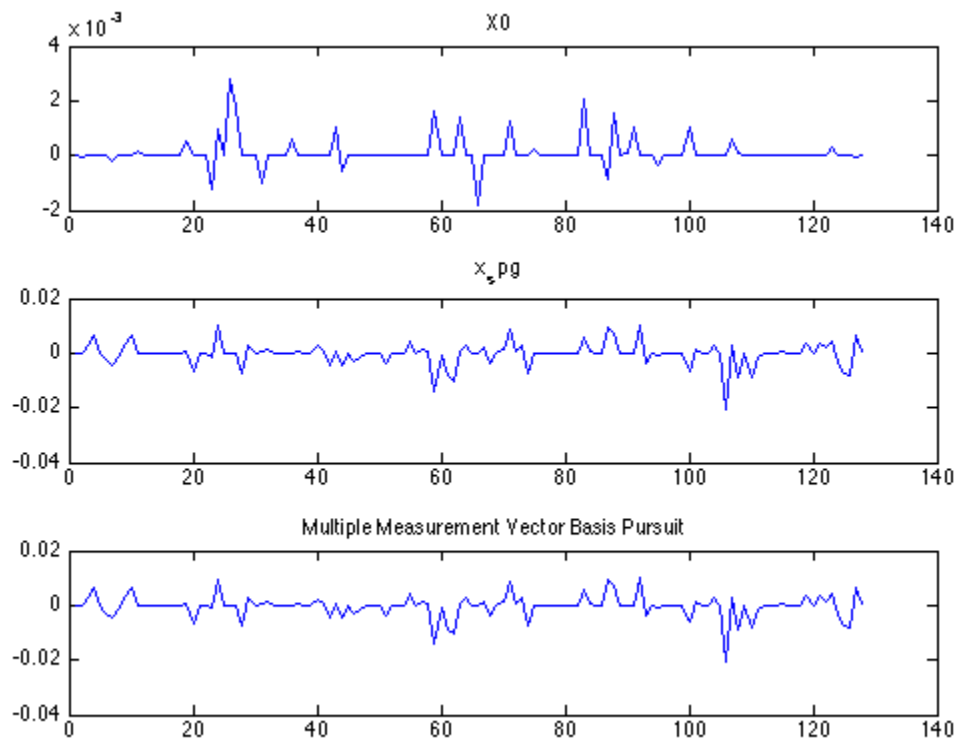
---

```

gNorm: 1.6911e-04

stat: 1
iter: 45
nProdA: 49
nProdAt: 49
nNewton: 3
timeProject: 4.5234
timeMatProd: 0.2161
itnLSQR: 0
options: [1x1 struct]
timeTotal: 4.6322
xNorm1: [45x1 double]
rNorm2: [45x1 double]
lambda: [45x1 double]

```

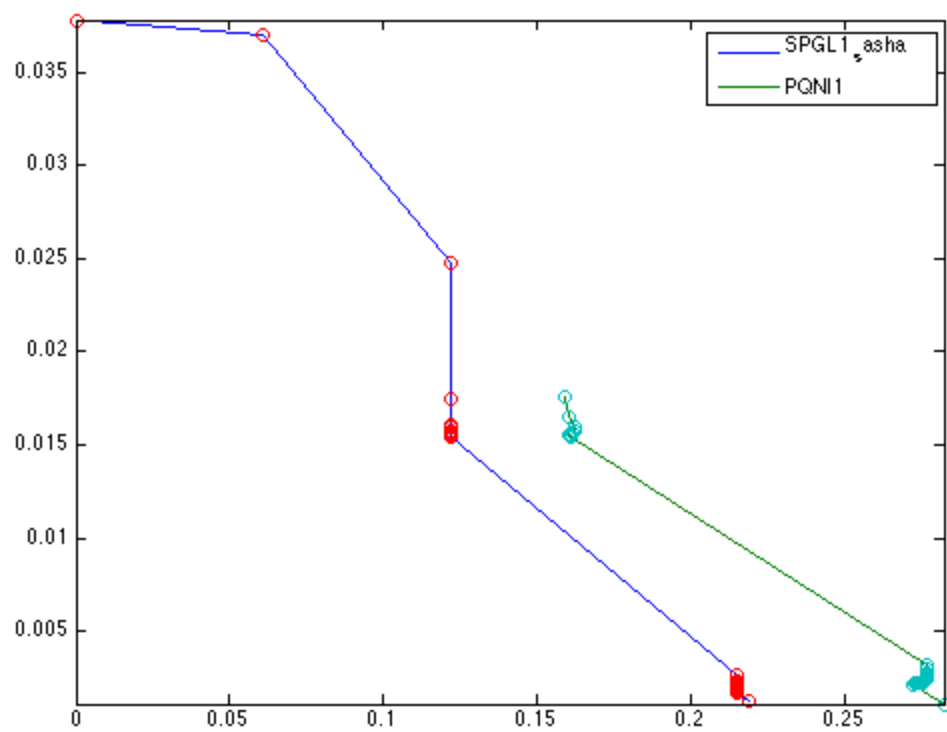


## show result

```

figure('Name','Solution paths')
plot(info_spg.xNorm1,info_spg.rNorm2,info_pqn1.xNorm1,info_pqn1.rNorm2);hold on
scatter(info_spg.xNorm1,info_spg.rNorm2);
scatter(info_pqn1.xNorm1,info_pqn1.rNorm2);hold off
legend('SPGL1_sasha','PQN11')
axis tight

```



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