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```
%Sequential-source data reconstruction (acquistion with randomly jittered missing
clear; close all;
cd ./functions
addpath(genpath(pwd))
cd ..
cd ./simu_functions/
addpath(genpath(pwd))
cd ..
```

original data

Number of time samples

```
nt = 1024;
% Number of sources
ns = 178;
% Number of receivers
nr = 178;

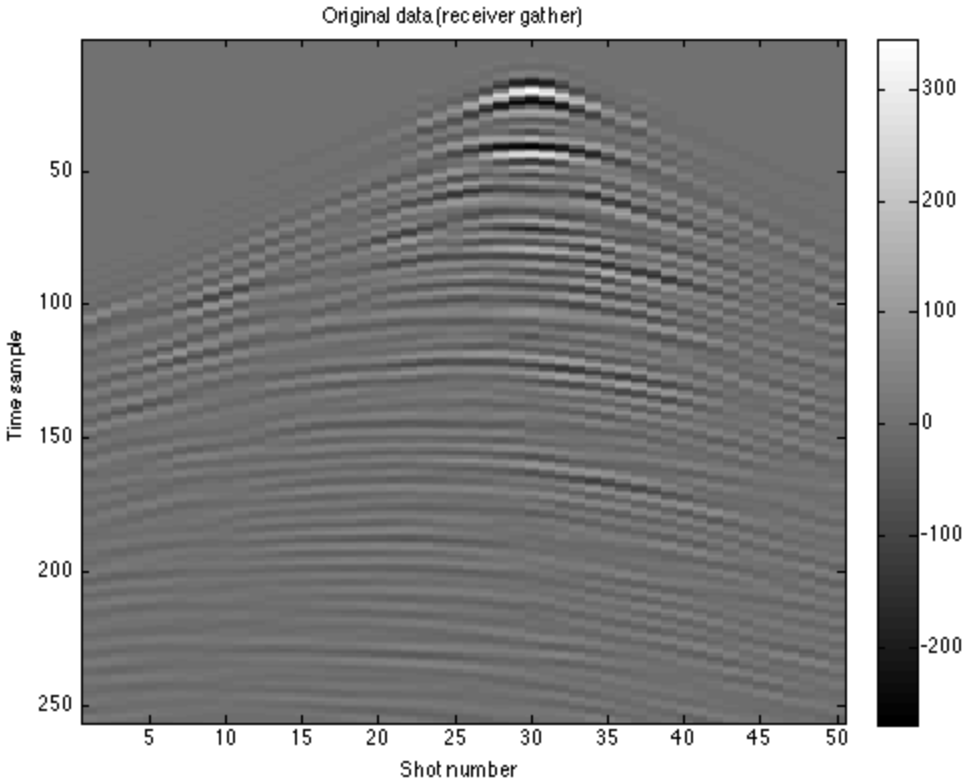
% Read data
D = ReadSuFast('GulfOfSuez178.su');
D = reshape(D,nt,nr,ns);

% Select small subset
D = D(1:256,30,1:50);

% Define new data sizes
[nt,nr,ns] = size(D);

% Vectorize D
D = D(:);

% Display
figure
imagesc(reshape(D,nt,ns)); colormap(gray); colorbar;
title('Original data (receiver gather)');
xlabel('Shot number'); ylabel('Time sample')
```



random jittering missing shots

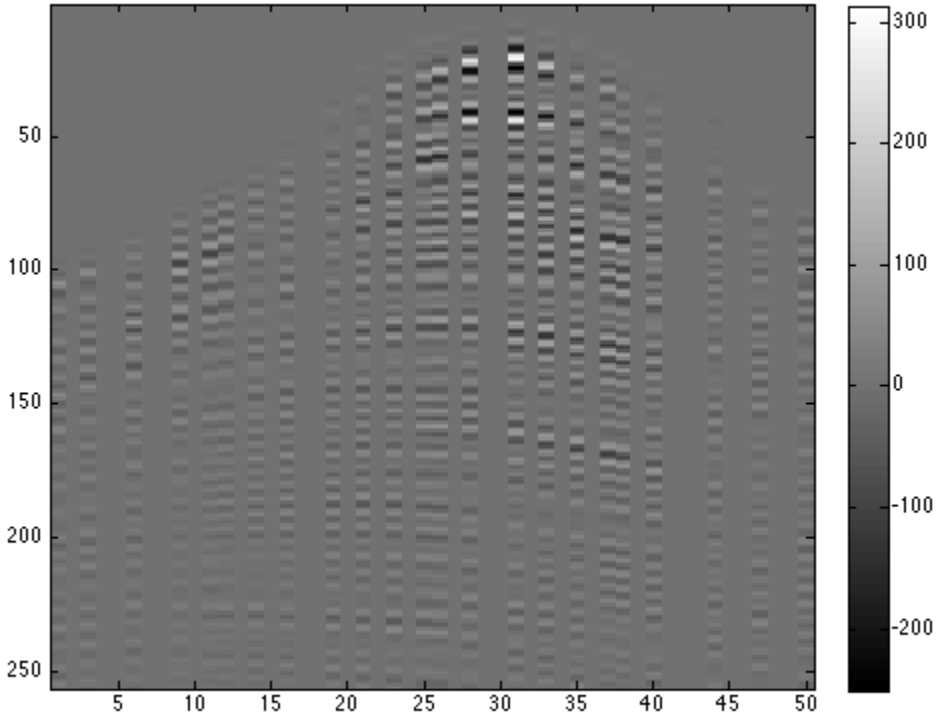
random jittering missing shots

```
n = ns;
p = .5;
I_jitter = jitter1d(n,p*n);
S_jitter = zeros(n,1); S_jitter(I_jitter) = 1;
Js = opDiag(S_jitter);
Dt = opDirac(nt);
Dr = opDirac(nr);
RM = opKron(Js,Dr,Dt);


x_test = rand(size(RM,2),1);
y_test = rand(size(RM,1),1);
left = y_test'*(RM*x_test);
right = (RM'*y_test)'*x_test;
error = norm(left-right);
fprintf('In dottest error:%5.5e\n',error);


simD1 = RM*D;
figure;
imagesc(reshape(simD1,nt,ns)); colormap(gray); colorbar;
```

```
In dottest error:0.00000e+00
```

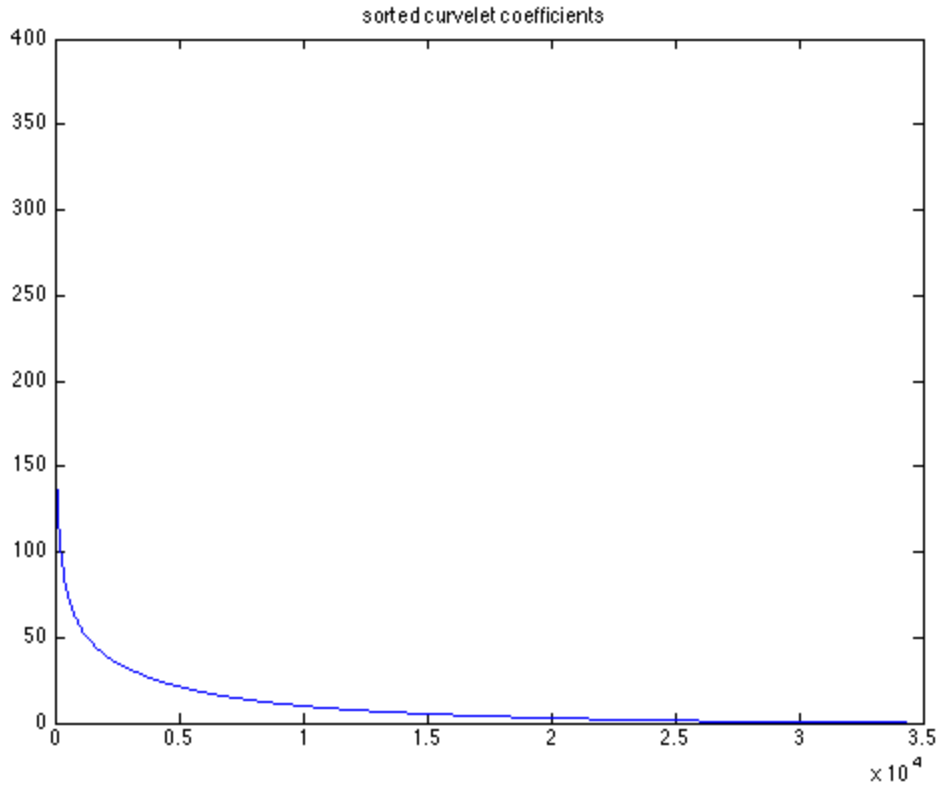


sparsifying transform

Use this to create a Curvelet SPOT operator:

```
C = opCurvelet(nt, ns);

% Transform the data into the Curvelet domain and plot the sorted coefficients
C_D = C*D;
sort_CD = sort(abs(C_D),'descend');
figure;plot(sort_CD);title('sorted curvelet coefficients')
```



reconstruct

```
options = spgSetParms('optTol', 1e-4, 'iterations', 200);%, 'fid', fid);
A = RM*C';
xestspg = spgl1_origin(A,simD1,0,1e-3,[],options);
options.iterations = 100;
xestpqn = pqnl1_2(A,simD1,0,1e-3,[],options);
fspg = C'*xestspg;
snrspg = SNR(D,fspg);
fpqn = C'*xestpqn;
snrpqn = SNR(D,fpqn);



figure;
subplot(1,2,1);imagesc(reshape(fspg,nt,ns)); colormap(gray);
title(strcat(['p = .5, SNR=' num2str(snrspg) 'dB']))
subplot(1,2,2);imagesc(reshape(fspg-D,nt,ns)); colormap(gray);
title('difference')


figure;
subplot(1,2,1);imagesc(reshape(fpqn,nt,ns)); colormap(gray);
title(strcat(['p = .5, SNR=' num2str(snrpqn) 'dB']))
subplot(1,2,2);imagesc(reshape(fpqn-D,nt,ns)); colormap(gray);
```

```
title('difference')
```

```
================================================================================
SPGL1_SLIM v. 46  (Tue, 14 Jun 2011) based on v.1017
================================================================================
No. rows              :    12800      No. columns           :    34341
Initial tau           : 0.00e+00      Two-norm of b         : 2.64e+03
Optimality tol        : 1.00e-04      Target objective      : 1.00e-03
Basis pursuit tol     : 1.00e-06      Maximum iterations    :      200

 Iter      Objective   Relative Gap  Rel Error      gNorm   stepG    nnzX
    0  2.6389899e+03  0.0000000e+00   1.00e+00  1.876e+02     0.0       0
    1  2.6287853e+03  2.2513760e+00   1.00e+00  2.095e+02    -0.3       1
    2  1.8740238e+03  1.5072574e+00   1.00e+00  9.797e+01     0.0    1549
    3  1.8264840e+03  4.6143469e-01   1.00e+00  5.253e+01     0.0    1466
    4  1.7999387e+03  5.5613826e-01   1.00e+00  5.568e+01     0.0    1116
    5  1.7844575e+03  1.9857142e+00   1.00e+00  1.159e+02     0.0     743
    6  1.7846402e+03  3.6264302e+00   1.00e+00  1.845e+02    -0.3     701
    7  1.7648037e+03  2.8218139e-01   1.00e+00  4.319e+01     0.0     739
    8  1.7630308e+03  2.3934422e-01   1.00e+00  4.140e+01     0.0     726
    9  1.7581369e+03  2.2286082e-01   1.00e+00  4.068e+01     0.0     688
   10  1.7594838e+03  2.1478530e+00   1.00e+00  1.168e+02     0.0     386
   11  1.7479251e+03  5.8097667e-01   1.00e+00  5.317e+01    -0.3     470
   12  1.7439611e+03  2.4412741e-01   1.00e+00  3.991e+01     0.0     534
   13  1.7429302e+03  9.3058756e-02   1.00e+00  3.404e+01     0.0     535
   14  1.7422920e+03  9.0152805e-02   1.00e+00  3.410e+01     0.0     534
   15  1.7415890e+03  2.0296105e-01   1.00e+00  3.893e+01     0.0     531
   16  1.7416583e+03  4.6665537e-01   1.00e+00  4.963e+01    -0.3     535
   17  9.9035306e+02  2.0194336e+00   1.00e+00  2.111e+01     0.0    6458
   18  9.5140206e+02  1.4078516e+00   1.00e+00  1.824e+01     0.0    5555
   19  9.1158094e+02  1.0298405e+00   1.00e+00  1.563e+01     0.0    3834
   20  9.0739515e+02  7.3002655e+00   1.00e+00  4.157e+01     0.0    2746
   21  8.9698218e+02  6.2541592e+00   1.00e+00  3.592e+01    -0.3    2643
   22  8.7801844e+02  1.3823982e+00   1.00e+00  1.636e+01     0.0    2809
   23  8.7632077e+02  6.6468314e-01   1.00e+00  1.351e+01     0.0    2752
   24  8.7456060e+02  6.0968996e-01   1.00e+00  1.327e+01     0.0    2681
   25  8.6731165e+02  2.4626191e+00   1.00e+00  1.997e+01     0.0    2081
   26  8.6584121e+02  4.6069139e+00   1.00e+00  2.829e+01    -0.3    2195
   27  8.6357607e+02  1.6045193e+00   1.00e+00  1.679e+01     0.0    2270
   28  8.6288978e+02  3.6556360e-01   1.00e+00  1.211e+01     0.0    2252
   29  8.6256889e+02  3.5283351e-01   1.00e+00  1.206e+01     0.0    2245
   30  8.6073697e+02  9.2612112e-01   1.00e+00  1.421e+01     0.0    2170
   31  8.6274416e+02  4.5868464e+00   1.00e+00  2.804e+01    -0.3    2197
   32  8.6201209e+02  5.6025811e+00   1.00e+00  3.184e+01     0.0    2171
   33  8.5946493e+02  3.1325848e-01   1.00e+00  1.187e+01     0.0    2188
   34  8.5935934e+02  3.1666733e-01   1.00e+00  1.188e+01     0.0    2180
   35  8.5821104e+02  3.3292664e-01   1.00e+00  1.192e+01     0.0    2103
   36  8.5795264e+02  4.7765784e-01   1.00e+00  1.246e+01    -0.3    2116
   37  8.5791187e+02  1.2474012e+00   1.00e+00  1.533e+01    -0.3    2102
   38  3.8486241e+02  7.2208309e+00   1.00e+00  6.998e+00     0.0    9815
   39  3.6394935e+02  3.8333743e+00   1.00e+00  5.443e+00     0.0    9478
   40  3.5218713e+02  3.1212832e+00   1.00e+00  4.920e+00     0.0    8056
   41  3.4001808e+02  1.2157962e+01   1.00e+00  8.219e+00     0.0    5681
```

42	3.5599078e+02	2.9428561e+01	1.00e+00	1.595e+01	-0.3	5245
43	3.3079264e+02	6.9964135e+00	1.00e+00	5.997e+00	0.0	5764
44	3.2858346e+02	2.2089254e+00	1.00e+00	4.186e+00	0.0	5517
45	3.2784491e+02	2.1197863e+00	1.00e+00	4.142e+00	0.0	5371
46	3.2388624e+02	3.2986683e+00	1.00e+00	4.499e+00	0.0	4747
47	3.2310430e+02	2.2634127e+00	1.00e+00	4.133e+00	-0.3	4815
48	3.2258938e+02	3.3963660e+00	1.00e+00	4.522e+00	0.0	4791
49	3.2211531e+02	1.8254319e+00	1.00e+00	3.963e+00	0.0	4727
50	3.2174788e+02	1.5371803e+00	1.00e+00	3.855e+00	0.0	4721
51	3.2139626e+02	1.4629020e+00	1.00e+00	3.826e+00	0.0	4678
52	3.2090527e+02	4.1546445e+00	1.00e+00	4.764e+00	0.0	4580
53	3.2074129e+02	4.0968029e+00	1.00e+00	4.742e+00	-0.3	4536
54	3.2019453e+02	1.6707966e+00	1.00e+00	3.886e+00	0.0	4526
55	3.2000652e+02	1.2310951e+00	1.00e+00	3.730e+00	0.0	4511
56	3.1967761e+02	1.2181858e+00	1.00e+00	3.723e+00	0.0	4460
57	3.1889751e+02	7.0783473e+00	1.00e+00	5.738e+00	-0.3	4243
58	3.1975525e+02	1.5656497e+01	1.00e+00	8.776e+00	-0.3	4271
59	3.1765823e+02	1.1123219e+00	1.00e+00	3.672e+00	0.0	4283
60	3.1756088e+02	1.1001296e+00	1.00e+00	3.666e+00	0.0	4268
61	3.1734024e+02	1.0963133e+00	1.00e+00	3.658e+00	0.0	4244
62	3.1621613e+02	4.3275401e+00	1.00e+00	4.760e+00	0.0	4068
63	3.1733402e+02	8.1714669e+00	1.00e+00	6.078e+00	-0.3	4110
64	3.1593572e+02	5.8266843e+00	1.00e+00	5.260e+00	0.0	4131
65	3.1559679e+02	1.0736950e+00	1.00e+00	3.636e+00	0.0	4131
66	3.1554649e+02	1.0804202e+00	1.00e+00	3.638e+00	0.0	4116
67	3.1531742e+02	1.1019569e+00	1.00e+00	3.641e+00	0.0	4053
68	3.1529908e+02	1.4768399e+01	1.00e+00	8.280e+00	-0.3	3947
69	3.1466831e+02	1.9704087e+00	1.00e+00	3.930e+00	-0.3	4031
70	3.1452798e+02	1.2819358e+00	1.00e+00	3.695e+00	0.0	4002
71	3.1447308e+02	8.4581804e-01	1.00e+00	3.547e+00	0.0	3982
72	3.1432251e+02	1.8873754e+00	1.00e+00	3.896e+00	0.0	3945
73	3.1440983e+02	4.3743312e+00	1.00e+00	4.733e+00	-0.3	3938
74	3.1428094e+02	7.3575613e+00	1.00e+00	5.741e+00	-0.3	3947
75	3.1401445e+02	7.6472407e-01	1.00e+00	3.513e+00	0.0	3944
76	3.1398901e+02	7.6203528e-01	1.00e+00	3.513e+00	0.0	3941
77	3.1382228e+02	7.5514085e-01	1.00e+00	3.509e+00	0.0	3920
78	3.1359960e+02	8.7535590e+00	1.00e+00	6.193e+00	-0.3	3920
79	3.1389226e+02	6.9389808e+00	1.00e+00	5.589e+00	-0.3	3944
80	3.1333744e+02	2.7938303e+00	1.00e+00	4.191e+00	0.0	3919
81	3.1329918e+02	7.3869636e-01	1.00e+00	3.500e+00	0.0	3915
82	3.1326883e+02	7.3765133e-01	1.00e+00	3.498e+00	0.0	3906
83	3.1281078e+02	3.5480588e+00	1.00e+00	4.429e+00	0.0	3822
84	3.1303595e+02	5.7035826e+00	1.00e+00	5.170e+00	-0.3	3841
85	3.1296478e+02	5.2168449e+00	1.00e+00	4.983e+00	0.0	3887
86	3.1263978e+02	8.3114099e-01	1.00e+00	3.524e+00	0.0	3870
87	3.1262112e+02	7.3099680e-01	1.00e+00	3.489e+00	0.0	3866
88	3.1258720e+02	7.2403117e-01	1.00e+00	3.487e+00	0.0	3849
89	3.1196746e+02	5.6557566e+00	1.00e+00	5.104e+00	0.0	3738
90	3.1222339e+02	1.0132680e+01	1.00e+00	6.635e+00	-0.3	3762
91	3.1172948e+02	2.0047463e+00	1.00e+00	3.906e+00	0.0	3803
92	3.1168909e+02	6.4268208e-01	1.00e+00	3.453e+00	0.0	3787
93	3.1167571e+02	6.3241664e-01	1.00e+00	3.448e+00	0.0	3778
94	1.5145837e+02	8.1055535e+01	1.00e+00	4.973e+00	0.0	5351
95	8.8933547e+01	1.1903461e+02	1.00e+00	3.399e+00	0.0	15941

96	5.8513768e+01	4.3583824e+01	1.00e+00	8.557e-01	0.0	14820
97	5.5874963e+01	4.1915478e+01	1.00e+00	8.112e-01	0.0	13360
98	5.1825409e+01	3.1568718e+01	1.00e+00	6.818e-01	0.0	11130
99	5.0483465e+01	9.5673693e+01	1.00e+00	1.077e+00	0.0	9327
100	5.0411704e+01	1.2332884e+02	1.00e+00	1.318e+00	-0.3	9523
101	4.7321970e+01	3.2120634e+01	1.00e+00	6.128e-01	0.0	9321
102	4.6896432e+01	2.4168404e+01	1.00e+00	5.537e-01	0.0	9119
103	4.6617181e+01	2.3565207e+01	1.00e+00	5.458e-01	0.0	8960
104	4.4900636e+01	6.6607717e+01	1.00e+00	7.781e-01	0.0	7977
105	4.5799459e+01	9.7228426e+01	1.00e+00	9.746e-01	-0.3	8083
106	4.4139075e+01	3.6337383e+01	1.00e+00	5.856e-01	0.0	8155
107	4.3934550e+01	1.9760075e+01	1.00e+00	4.927e-01	0.0	8031
108	4.3831797e+01	1.9843403e+01	1.00e+00	4.917e-01	0.0	7966
109	4.2633790e+01	7.0380173e+01	1.00e+00	7.438e-01	0.0	7300
110	4.3212762e+01	1.4602527e+02	1.00e+00	1.152e+00	-0.3	7417
111	4.2375235e+01	9.0663103e+01	1.00e+00	8.338e-01	0.0	7830
112	4.1972475e+01	1.5794766e+01	1.00e+00	4.496e-01	0.0	7489
113	4.1922421e+01	1.3404799e+01	1.00e+00	4.367e-01	0.0	7428
114	4.1799893e+01	1.3372688e+01	1.00e+00	4.354e-01	0.0	7326
115	4.1613881e+01	8.2564203e+01	1.00e+00	7.698e-01	0.0	6948
116	4.0934598e+01	3.0032635e+01	1.00e+00	5.104e-01	-0.3	7044
117	4.0795038e+01	1.4214791e+01	1.00e+00	4.299e-01	0.0	7040
118	4.0751187e+01	1.1405969e+01	1.00e+00	4.158e-01	0.0	7005
119	4.0617894e+01	1.2115450e+01	1.00e+00	4.166e-01	0.0	6931
120	4.0586754e+01	3.3967035e+01	1.00e+00	5.219e-01	-0.3	6892
121	4.0604403e+01	4.9321336e+01	1.00e+00	5.889e-01	-0.3	6894
122	4.0408595e+01	1.0417964e+01	1.00e+00	4.074e-01	0.0	6878
123	4.0387403e+01	1.0407395e+01	1.00e+00	4.069e-01	0.0	6872
124	4.0332233e+01	1.0333200e+01	1.00e+00	4.060e-01	0.0	6854
125	4.0056367e+01	9.7666999e+01	1.00e+00	7.995e-01	-0.3	6449
126	3.9564658e+01	5.1792005e+01	1.00e+00	5.925e-01	-0.3	6552
127	3.9276899e+01	2.5161370e+01	1.00e+00	4.643e-01	0.0	6634
128	3.9233557e+01	2.4182205e+01	1.00e+00	4.592e-01	0.0	6593
129	3.9159095e+01	1.2907647e+01	1.00e+00	4.071e-01	0.0	6555
130	3.9071837e+01	1.8080929e+01	1.00e+00	4.297e-01	0.0	6525
131	3.9033419e+01	9.8775192e+00	1.00e+00	3.917e-01	-0.3	6555
132	3.9017393e+01	8.6282469e+00	1.00e+00	3.865e-01	0.0	6535
133	3.8999626e+01	8.5548147e+00	1.00e+00	3.858e-01	0.0	6526
134	3.8915490e+01	2.6058632e+01	1.00e+00	4.618e-01	0.0	6459
135	3.8948355e+01	4.0746677e+01	1.00e+00	5.229e-01	-0.3	6485
136	3.8833222e+01	8.2278211e+00	1.00e+00	3.830e-01	0.0	6474
137	3.8825186e+01	8.2633393e+00	1.00e+00	3.829e-01	0.0	6470
138	3.8771004e+01	8.1923102e+00	1.00e+00	3.820e-01	0.0	6452
139	3.8628994e+01	3.5695445e+01	1.00e+00	4.981e-01	-0.3	6455
140	3.8560585e+01	2.6557023e+01	1.00e+00	4.606e-01	-0.3	6478
141	3.8485116e+01	7.4728688e+00	1.00e+00	3.769e-01	0.0	6458
142	3.8473203e+01	7.9413109e+00	1.00e+00	3.788e-01	0.0	6443
143	3.8448532e+01	8.4729947e+00	1.00e+00	3.803e-01	0.0	6428
144	3.8377119e+01	2.2574976e+01	1.00e+00	4.392e-01	0.0	6372
145	3.8432157e+01	4.0262393e+01	1.00e+00	5.122e-01	-0.3	6402
146	3.8314003e+01	8.5757131e+00	1.00e+00	3.791e-01	0.0	6387
147	3.8306506e+01	8.3543514e+00	1.00e+00	3.780e-01	0.0	6385
148	3.8290622e+01	8.1365438e+00	1.00e+00	3.769e-01	0.0	6376
149	3.8040324e+01	6.2762614e+01	1.00e+00	5.986e-01	0.0	6114

150	3.8249640e+01	8.0512554e+01	1.00e+00	6.853e-01	-0.3	6210
151	3.7730120e+01	3.6096418e+01	1.00e+00	4.865e-01	0.0	6359
152	3.7668836e+01	1.4095146e+01	1.00e+00	3.971e-01	0.0	6263
153	3.7653807e+01	1.1047334e+01	1.00e+00	3.841e-01	0.0	6242
154	3.7596463e+01	9.3127344e+00	1.00e+00	3.750e-01	0.0	6186
155	3.7623665e+01	3.5610486e+01	1.00e+00	4.837e-01	0.0	6177
156	3.7632960e+01	3.4124693e+01	1.00e+00	4.759e-01	-0.3	6213
157	3.7531614e+01	9.0295633e+00	1.00e+00	3.733e-01	0.0	6192
158	3.7523823e+01	8.2916606e+00	1.00e+00	3.705e-01	0.0	6176
159	3.7518267e+01	8.1023787e+00	1.00e+00	3.696e-01	0.0	6172
160	3.7371536e+01	3.1872741e+01	1.00e+00	4.627e-01	0.0	6090
161	3.7399159e+01	3.3565290e+01	1.00e+00	4.707e-01	-0.3	6127
162	3.7364529e+01	2.0184607e+01	1.00e+00	4.164e-01	0.0	6142
163	3.7330827e+01	8.2645443e+00	1.00e+00	3.684e-01	0.0	6133
164	3.7327170e+01	8.2000899e+00	1.00e+00	3.682e-01	0.0	6125
165	3.7297967e+01	1.0367101e+01	1.00e+00	3.763e-01	0.0	6104
166	3.7278874e+01	7.2775283e+01	1.00e+00	6.253e-01	-0.3	6111
167	3.7260456e+01	2.1670362e+01	1.00e+00	4.213e-01	-0.3	6139
168	3.7253652e+01	1.2873084e+01	1.00e+00	3.861e-01	0.0	6114
169	3.7247979e+01	7.9240078e+00	1.00e+00	3.663e-01	0.0	6105
170	3.7228348e+01	2.2131987e+01	1.00e+00	4.225e-01	0.0	6082
171	3.7223703e+01	2.6103594e+01	1.00e+00	4.381e-01	-0.3	6093
172	3.7214718e+01	7.8657753e+00	1.00e+00	3.658e-01	0.0	6089
173	3.7210432e+01	7.8534632e+00	1.00e+00	3.656e-01	0.0	6090
174	3.7202678e+01	7.8522703e+00	1.00e+00	3.656e-01	0.0	6088
175	3.7191442e+01	3.3422418e+01	1.00e+00	4.665e-01	-0.3	6072
176	3.7161394e+01	7.8134146e+00	1.00e+00	3.651e-01	-0.3	6073
177	3.7157114e+01	7.7954023e+00	1.00e+00	3.650e-01	0.0	6069
178	3.7151884e+01	7.7855895e+00	1.00e+00	3.649e-01	0.0	6067
179	3.6905119e+01	6.2239480e+01	1.00e+00	5.738e-01	0.0	5934
180	3.7061314e+01	8.6759785e+01	1.00e+00	6.792e-01	-0.3	5985
181	3.6695763e+01	1.5244507e+01	1.00e+00	3.909e-01	0.0	6082
182	3.6679485e+01	8.9379913e+00	1.00e+00	3.664e-01	0.0	6037
183	3.6671786e+01	6.9414047e+00	1.00e+00	3.582e-01	0.0	6027
184	3.6649228e+01	7.2220698e+00	1.00e+00	3.581e-01	0.0	6003
185	3.6646830e+01	3.7895910e+01	1.00e+00	4.777e-01	0.0	5990
186	3.6619576e+01	1.0796380e+01	1.00e+00	3.726e-01	-0.3	6019
187	3.6611913e+01	7.3771667e+00	1.00e+00	3.589e-01	0.0	6006
188	3.6607581e+01	7.2210790e+00	1.00e+00	3.581e-01	0.0	5998
189	3.6600358e+01	7.0560553e+00	1.00e+00	3.571e-01	0.0	5994
190	3.6601019e+01	1.4576108e+01	1.00e+00	3.862e-01	-0.3	5990
191	1.0327891e+01	6.5442898e+02	1.00e+00	2.544e-01	0.0	16472
192	8.9409964e+00	1.6161258e+02	1.00e+00	1.086e-01	0.0	17848
193	8.5831325e+00	1.5511519e+02	1.00e+00	1.021e-01	0.0	16145
194	7.8040104e+00	3.5627920e+02	1.00e+00	1.265e-01	0.0	12815
195	8.4027360e+00	1.0453616e+03	1.00e+00	2.662e-01	-0.3	11518
196	7.5986696e+00	6.4529876e+02	1.00e+00	1.645e-01	0.0	12854
197	7.2511178e+00	1.4401387e+02	1.00e+00	8.140e-02	0.0	11612
198	7.2031487e+00	1.1823204e+02	1.00e+00	7.691e-02	0.0	11390
199	7.0411909e+00	1.0170962e+02	1.00e+00	7.312e-02	0.0	10711
200	7.0264003e+00	8.1998681e+02	1.00e+00	1.685e-01	-0.3	9645

ERROR EXIT -- Too many iterations

```
 Products with A     :     280        Total time   (secs) :   196.1
 Products with A'    :     202        Project time (secs) :     1.1
 Newton iterations   :       5        Mat-vec time (secs) :   193.8
 Line search its     :     135        Subspace iterations :       0


 ===============================================================================
 PQNL1_SLIM v. 46  (Tue, 14 Jun 2011) based on v.1017
 ===============================================================================
 No. rows              :    12800      No. columns           :    34341
 Initial tau           : 0.00e+00      Two-norm of b         : 2.64e+03
 Optimality tol        : 1.00e-04      Target objective      : 1.00e-03
 Basis pursuit tol     : 1.00e-06      Maximum iterations    :      100

     0  2.6389899e+03  0.0000000e+00   1.00e+00  1.876e+02     0.0       0
 Iteration   FunEvals Projections     Step Length          rNorm2        O
         1          2           4     1.00000e+00     1.90164e+03     1.030
         2          3          21     1.00000e+00     1.84754e+03     5.955
         3          4          48     1.00000e+00     1.80876e+03     3.325
         4          5          77     1.00000e+00     1.78974e+03     2.242
         5          6         108     1.00000e+00     1.77764e+03     1.815
         6          7         143     1.00000e+00     1.76891e+03     1.358
         7          8         182     1.00000e+00     1.76300e+03     1.143
         8         10         223     5.00000e-01     1.75981e+03     1.088
         9         12         262     5.00000e-01     1.75627e+03     9.965
        10         14         309     5.00000e-01     1.75319e+03     8.877
        11         16         354     5.00000e-01     1.75057e+03     7.765
        12         18         399     5.00000e-01     1.74851e+03     6.906
        13         20         444     5.00000e-01     1.74676e+03     6.097
        14         22         489     5.00000e-01     1.74536e+03     5.368
        15         25         540     2.50000e-01     1.74468e+03     4.989
        16         28         598     2.50000e-01     1.74390e+03     4.541
        17         31         654     2.50000e-01     1.74323e+03     4.115
 Function Evaluations exceeds maxIter
 Iteration   FunEvals Projections     Step Length          rNorm2        O
        18          2           4     1.00000e+00     1.74283e+03     2.860
        19          3          31     1.00000e+00     1.74217e+03     2.247
        20          4          63     1.00000e+00     1.74170e+03     2.185
        21          6         111     5.00000e-01     1.74132e+03     2.283
        22          9         167     2.50000e-01     1.74112e+03     2.298
        23         12         227     2.50000e-01     1.74088e+03     2.294
        24         16         285     1.25000e-01     1.74074e+03     2.271
 break of testUpdateTau    24  1.7407450e+03  4.5556981e+01   1.00e+00  3.2
 Iteration   FunEvals Projections     Step Length          rNorm2        O
        25          2           4     1.00000e+00     7.49133e+02     1.774
        26          3          19     1.00000e+00     6.84562e+02     1.093
        27          4          44     1.00000e+00     6.26908e+02     6.374
        28          5          71     1.00000e+00     5.95150e+02     4.588
        29          6          98     1.00000e+00     5.73258e+02     3.547
        30          7         129     1.00000e+00     5.57702e+02     2.783
        31          8         166     1.00000e+00     5.46351e+02     2.205
        32          9         205     1.00000e+00     5.38089e+02     1.828
        33         10         248     1.00000e+00     5.31352e+02     1.559
        34         11         289     1.00000e+00     5.25902e+02     1.347
```

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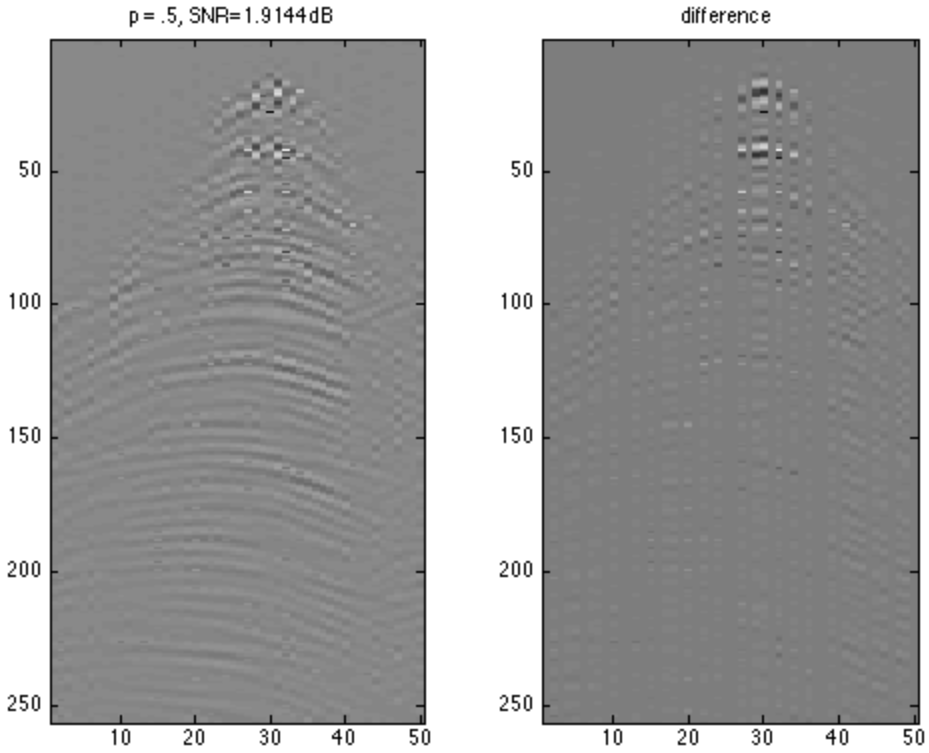
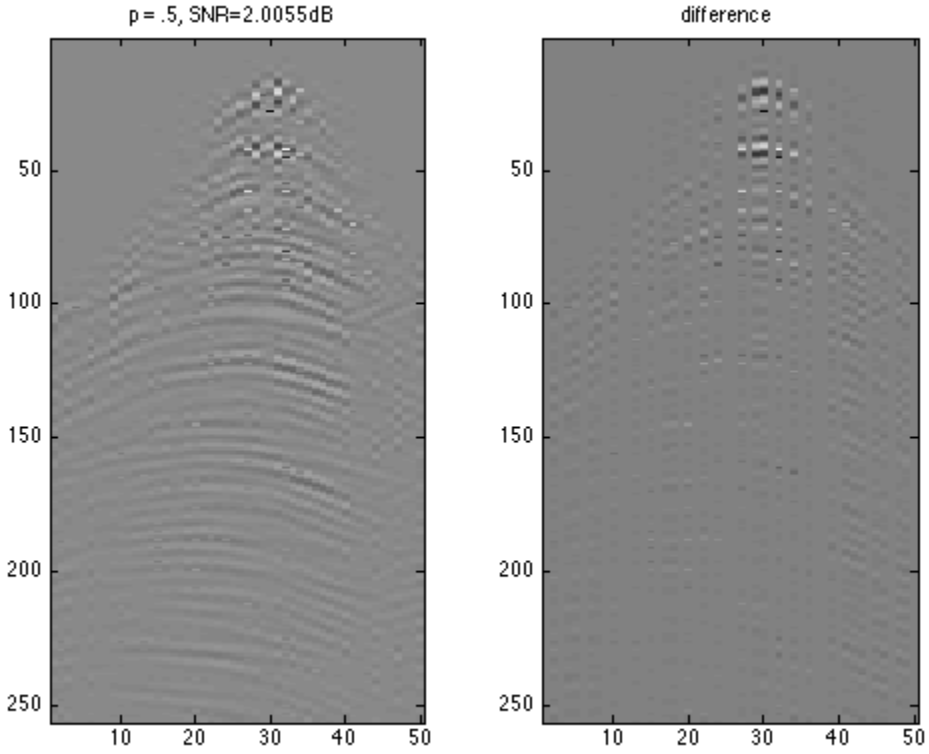
        35          12         338     1.00000e+00     5.21742e+02     1.165
        36          13         389     1.00000e+00     5.18352e+02     1.029
        37          14         434     1.00000e+00     5.15077e+02     9.464
        38          15         493     1.00000e+00     5.12438e+02     8.839
        39          16         552     1.00000e+00     5.10397e+02     7.923
        40          17         617     1.00000e+00     5.08338e+02     7.144
        41          18         675     1.00000e+00     5.06563e+02     6.839
        42          19         743     1.00000e+00     5.04921e+02     6.704
        43          20         801     1.00000e+00     5.03601e+02     6.236
        44          21         859     1.00000e+00     5.02415e+02     5.654
        45          22         917     1.00000e+00     5.01347e+02     5.247
        46          23         985     1.00000e+00     5.00445e+02     5.094
        47          24        1057     1.00000e+00     4.99566e+02     4.944
        48          25        1119     1.00000e+00     4.98848e+02     4.652
        49          26        1181     1.00000e+00     4.98188e+02     4.253
        50          27        1251     1.00000e+00     4.97561e+02     4.004
        51          28        1309     1.00000e+00     4.96975e+02     3.911
        52          30        1380     5.00000e-01     4.96673e+02     3.825
        53          32        1462     5.00000e-01     4.96308e+02     3.612
Function Evaluations exceeds maxIter
 Iteration   FunEvals Projections     Step Length          rNorm2          O
        54          2          4     1.00000e+00     4.96166e+02     2.866
        55          3         31     1.00000e+00     4.95799e+02     2.193
        56          4         64     1.00000e+00     4.95632e+02     2.632
        57          5        110     1.00000e+00     4.95456e+02     2.938
        58          6        157     1.00000e+00     4.95239e+02     3.015
        59          7        230     1.00000e+00     4.95009e+02     2.812
        60          9        297     5.00000e-01     4.94851e+02     2.729
        61         11        375     5.00000e-01     4.94648e+02     2.790
        62         13        458     5.00000e-01     4.94463e+02     2.872
        63         15        547     5.00000e-01     4.94284e+02     2.874
        64         17        614     5.00000e-01     4.94075e+02     2.825
        65         19        692     5.00000e-01     4.93881e+02     2.749
        66         22        761     2.50000e-01     4.93770e+02     2.675
        67         25        877     2.50000e-01     4.93643e+02     2.558
        68         28        974     2.50000e-01     4.93501e+02     2.445
        69         31       1070     2.50000e-01     4.93367e+02     2.345
Function Evaluations exceeds maxIter
 Iteration   FunEvals Projections     Step Length          rNorm2          O
        70          2          4     1.00000e+00     4.93303e+02     1.879
        71          3         31     1.00000e+00     4.93127e+02     1.481
        72          4         74     1.00000e+00     4.93061e+02     1.692
        73          5        110     1.00000e+00     4.92991e+02     1.743
        74          6        156     1.00000e+00     4.92910e+02     1.690
        75          7        214     1.00000e+00     4.92816e+02     1.774
        76          8        288     1.00000e+00     4.92723e+02     1.836
        77         10        372     5.00000e-01     4.92656e+02     1.812
        78         12        451     5.00000e-01     4.92585e+02     1.723
        79         14        523     5.00000e-01     4.92516e+02     1.620
        80         16        609     5.00000e-01     4.92451e+02     1.565
        81         18        718     5.00000e-01     4.92384e+02     1.616
        82         20        811     5.00000e-01     4.92315e+02     1.723
        83         22        889     5.00000e-01     4.92237e+02     1.828
        84         25        957     2.50000e-01     4.92184e+02     1.849
```

```
        85         28       1081     2.50000e-01     4.92125e+02     1.826
        86         31       1196     2.50000e-01     4.92064e+02     1.761
Function Evaluations exceeds maxIter
 Iteration   FunEvals Projections     Step Length          rNorm2        O
        87          2           4     1.00000e+00     4.92030e+02     1.328
break of testUpdateTau    87  4.9202981e+02  8.6079867e+01   1.00e+00  5.7
 Iteration   FunEvals Projections     Step Length          rNorm2        O
        88          2           4     1.00000e+00     1.49128e+02     5.670
        89          3          17     1.00000e+00     1.32120e+02     3.759
        90          4          44     1.00000e+00     1.14113e+02     2.186
        91          5          71     1.00000e+00     1.04513e+02     1.562
        92          6         100     1.00000e+00     9.77321e+01     1.183
        93          7         127     1.00000e+00     9.25346e+01     9.306
        94          8         158     1.00000e+00     8.86329e+01     7.651
        95          9         187     1.00000e+00     8.54782e+01     6.431
        96         10         226     1.00000e+00     8.30081e+01     5.505
        97         11         267     1.00000e+00     8.09496e+01     4.771
        98         12         306     1.00000e+00     7.93035e+01     4.220
        99         13         347     1.00000e+00     7.78446e+01     3.835
       100         14         400     1.00000e+00     7.65570e+01     3.596

 ERROR EXIT -- Too many iterations

 Products with A     :     158        Total time   (secs) :   172.3
 Products with A'    :     159        Project time (secs) :    55.7
 Newton iterations   :       3        Mat-vec time (secs) :   127.5
```


p = .5, SNR=1.9144dB
difference
50
100
150
200
250
10
20
30
40
50


p = .5, SNR=2.0055dB
difference
50
100
150
200
250
10
20
30
40
50

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