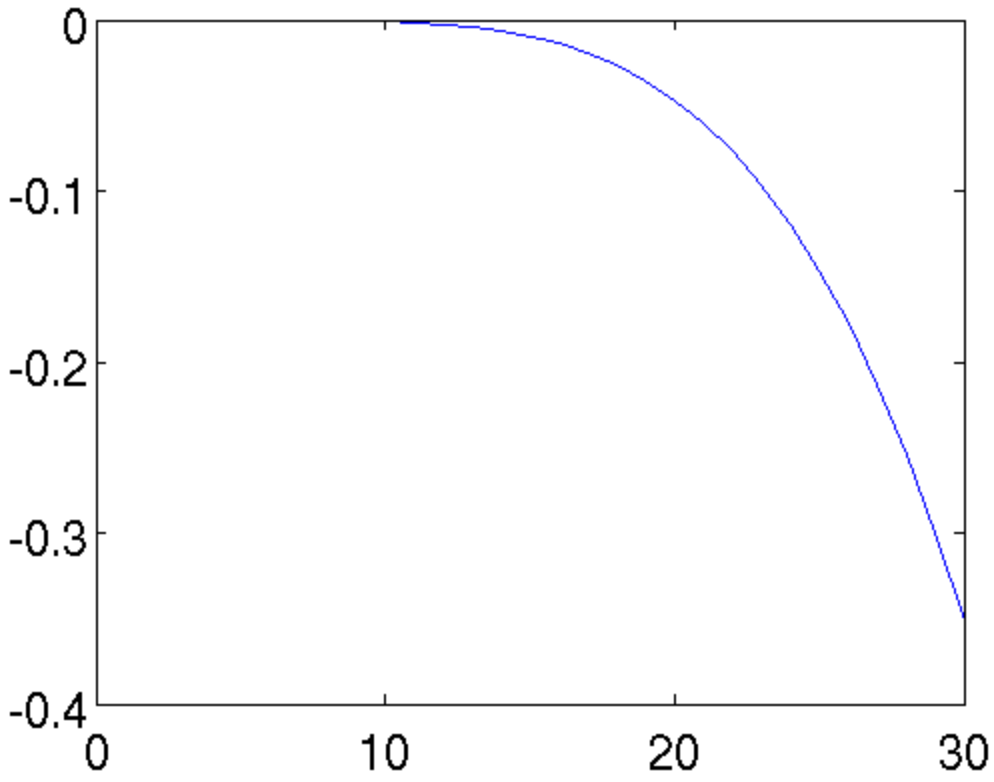
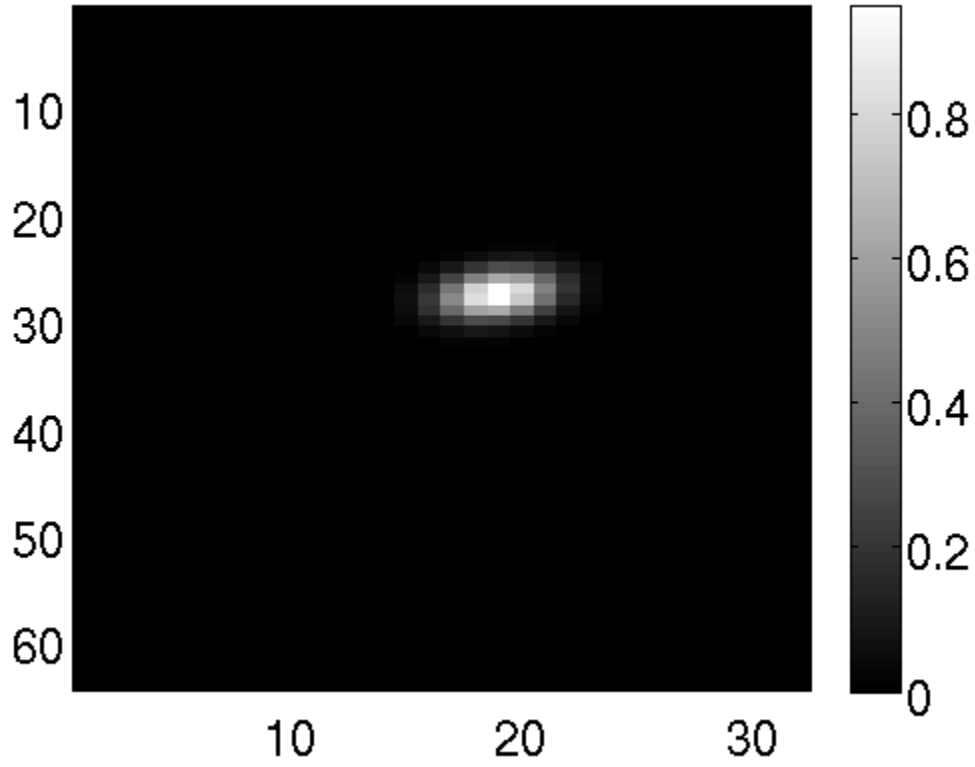
```
load('/Volumes/Analysis/nishal/Demo/null_data.mat');

fit_params = fit_sta(stas{2});
```

assign the parsed results to simpler (original) names

```
center_point = [fit_params.center_point_x, fit_params.center_point_y];
sd_scale = [fit_params.center_sd_x, fit_params.center_sd_y];
amp_scale =1%fit_params.surround_amp_scale;
rotation_angle = fit_params.center_rotation_angle;
x_dim =fit_params.x_dim;
y_dim = fit_params.y_dim;

% initialize the output matrix
output_matrix = zeros(y_dim, x_dim);

% make an array of points for matrix (STA) values
width_points = 1:1:x_dim;
height_points = 1:1:y_dim;

% calculate the distances of these points from the center of Gauss
width_dists = center_point(1) - width_points;
height_dists = center_point(2) - height_points;

% calculate rotation matrix: couterclockwise rotation with respect to angle
rotation_matrix = [cos(rotation_angle), -1*sin(rotation_angle); sin(rotation_angle

% define covariance matrix given the sd_scale and rotation matrix
covariance_matrix = rotation_matrix * [1/sd_scale(1)^2 0; 0 1/sd_scale(2)^2] * rot

% calculate the value of the Gaussian at each point in output_matrix
for wd = 1:x_dim
    for ht = 1:y_dim
        pt = [height_dists(ht); width_dists(wd)];
        output_matrix(ht,wd) = amp_scale .* exp(-0.5 .* (pt' * covariance_matrix *
    end
end
rf_center=output_matrix;



amp_scale =fit_params.surround_amp_scale;
surround_scale = fit_params.surround_sd_scale;
% initialize the output matrix
output_matrix = zeros(y_dim, x_dim);

% make an array of points for matrix (STA) values
width_points = 1:1:x_dim;
height_points = 1:1:y_dim;

% calculate the distances of these points from the center of Gauss
width_dists = center_point(1) - width_points;
```

```
height_dists = center_point(2) - height_points;

% calculate rotation matrix: couterclockwise rotation with respect to angle
rotation_matrix = [cos(rotation_angle), -1*sin(rotation_angle); sin(rotation_angle

% define covariance matrix given the sd_scale and rotation matrix
covariance_matrix = rotation_matrix * [1/sd_scale(1)^2 0; 0 1/sd_scale(2)^2] * rot

% calculate the value of the Gaussian at each point in output_matrix
for wd = 1:x_dim
    for ht = 1:y_dim
        pt = surround_scale*[height_dists(ht); width_dists(wd)]; %% Nishal DOUBT T
        output_matrix(ht,wd) = amp_scale .* exp(-0.5 .* (pt' * covariance_matrix *
    end
end

rf_surround=output_matrix;

rf_spatial=rf_center-rf_surround;

scale_one=fit_params.scale_one;
scale_two=fit_params.scale_two;
tau_one=fit_params.tau_one;
tau_two=fit_params.tau_two;
n_filters=fit_params.n_filters;
t=[0:29];
tf = scale_one*((t/tau_one).^n_filters).*exp(-n_filters*(t/tau_one -1)) - scale_tw
figure;plot(tf)

figure;
imagesc(rf_spatial);
colormap gray
colorbar


        amp_scale =

             1
```

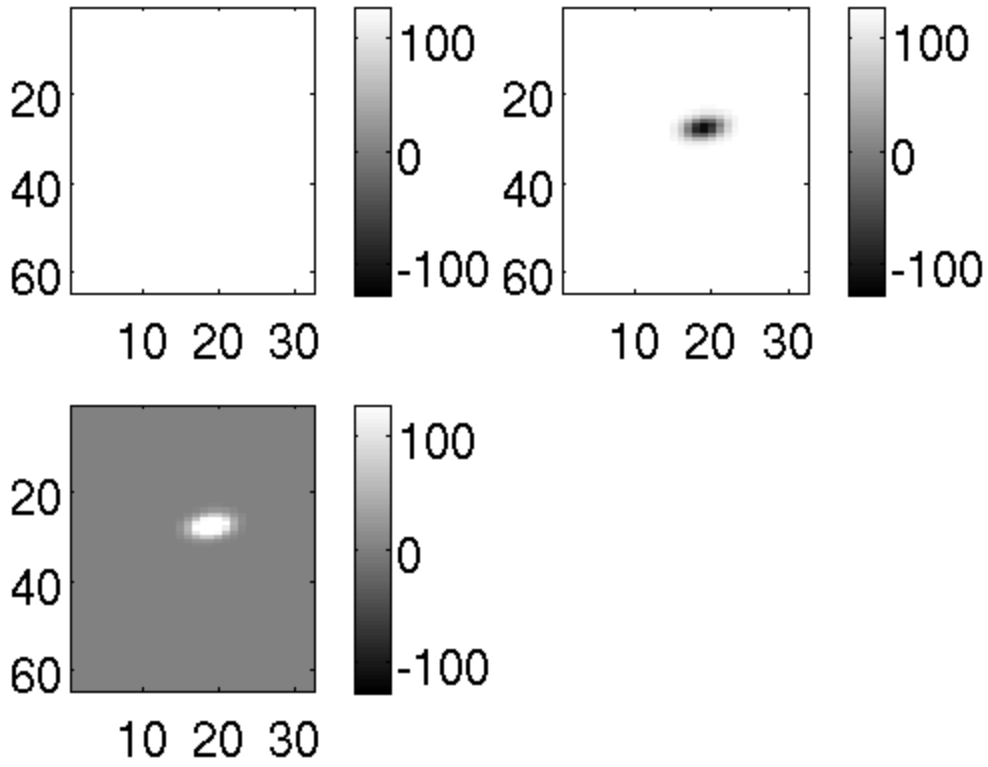

0
-0.1
-0.2
-0.3
-0.4
0
10
20
30


10
20
30
40
50
60
10
20
30
0.8
0.6
0.4
0.2
0

```
global_vars
stas=cell(1,1);
stas{1}=zeros(64,32,1,30);
stas{1}(:,:,1,1)=rf_spatial;


mov=ones(64,32,1200)*127.5;
movie_time=1200;
n_cell=1;

filt_dim1=64;
filt_dim2=32;
filt_len=30;
addpath('../lsqrSOL/');
addpath('../craigSOL/');
b= -Ax(stas,mov,movie_time,n_cell);
alpha=0.1;
beta=0.5;
momentum=0.7;

%  LSQR - Solve , change it to CRAIG when that starts working!
damp=0;
atol=10^-6;
btol=10^-6;
conlim=1.0e+300; % Doubt!
itnlim=1000;
show=1;

tic;
[ x, istop, itn, r1norm, r2norm, Anorm, Acond, Arnorm, xnorm, var ]...
   = lsqrSOL( movie_time*n_cell, movie_time*filt_dim1*filt_dim2, @dual_AAtx2, b(:)
toc;

mov_modify_new=reshape(x,[filt_dim1,filt_dim2,movie_time])+mov;
res=norm(Ax(stas,mov_modify_new,movie_time,n_cell))
mov_modify_new = mov_modify_new*127.5/max(abs(mov_modify_new(:)));
%
figure;
for itime=1200-20:1200

subplot(2,2,1);
imagesc(mov(:,:,itime));
colormap gray
colorbar
caxis([-127.5,127.5]);

subplot(2,2,2);
imagesc(mov_modify_new(:,:,itime));
colormap gray
colorbar
caxis([-127.5,127.5]);

subplot(2,2,3);
imagesc(mov(:,:,itime)-mov_modify_new(:,:,itime));
```

```
colormap gray
colorbar
caxis([-127.5,127.5]);

pause(0.1);
end
```

```
LSQR            Least-squares solution of  Ax = b
The matrix A has     1200 rows  and 2.4576e+06 cols
damp = 0.00000000000000e+00    wantvar =        1
atol = 1.00e-06                 conlim = 1.00e+300
btol = 1.00e-06                 itnlim =     1000

   Itn      x(1)       r1norm     r2norm  Compatible   LS      Norm A   Co
     0  0.00000e+00  7.426e+04  7.426e+04   1.0e+00  3.9e-05
     1 -8.32157e-100  3.749e-08  3.749e-08   5.0e-13  1.0e+00  2.9e+00  1.

lsqrSOL finished
Ax - b is small enough, given atol, btol

istop =       1   r1norm = 3.7e-08   Anorm = 2.9e+00   Arnorm = 1.1e-07
itn   =       1   r2norm = 3.7e-08   Acond = 1.0e+00   xnorm  = 2.6e+04

Elapsed time is 1.054781 seconds.

res =

   3.7504e-08
```




```
global_vars
stas=cell(1,1);
stas{1}=zeros(64,32,1,30);
stas{1}(:,:,1,1)=zeros(64,32);%rf_spatial;

for itime=1:30
    stas{1}(32,16,1,itime)=(-1)^itime;
end

%mov=ones(64,32,1200)*127.5;
mov=ones(64,32,1200);
for itime=1:1200
mov(:,:,itime)=ones(64,32)*(-1)^itime*127;
end

movie_time=1200;
n_cell=1;

filt_dim1=64;
filt_dim2=32;
filt_len=30;
addpath('../lsqrSOL/');
addpath('../craigSOL/');
b= -Ax(stas,mov,movie_time,n_cell);
alpha=0.1;
beta=0.5;
```

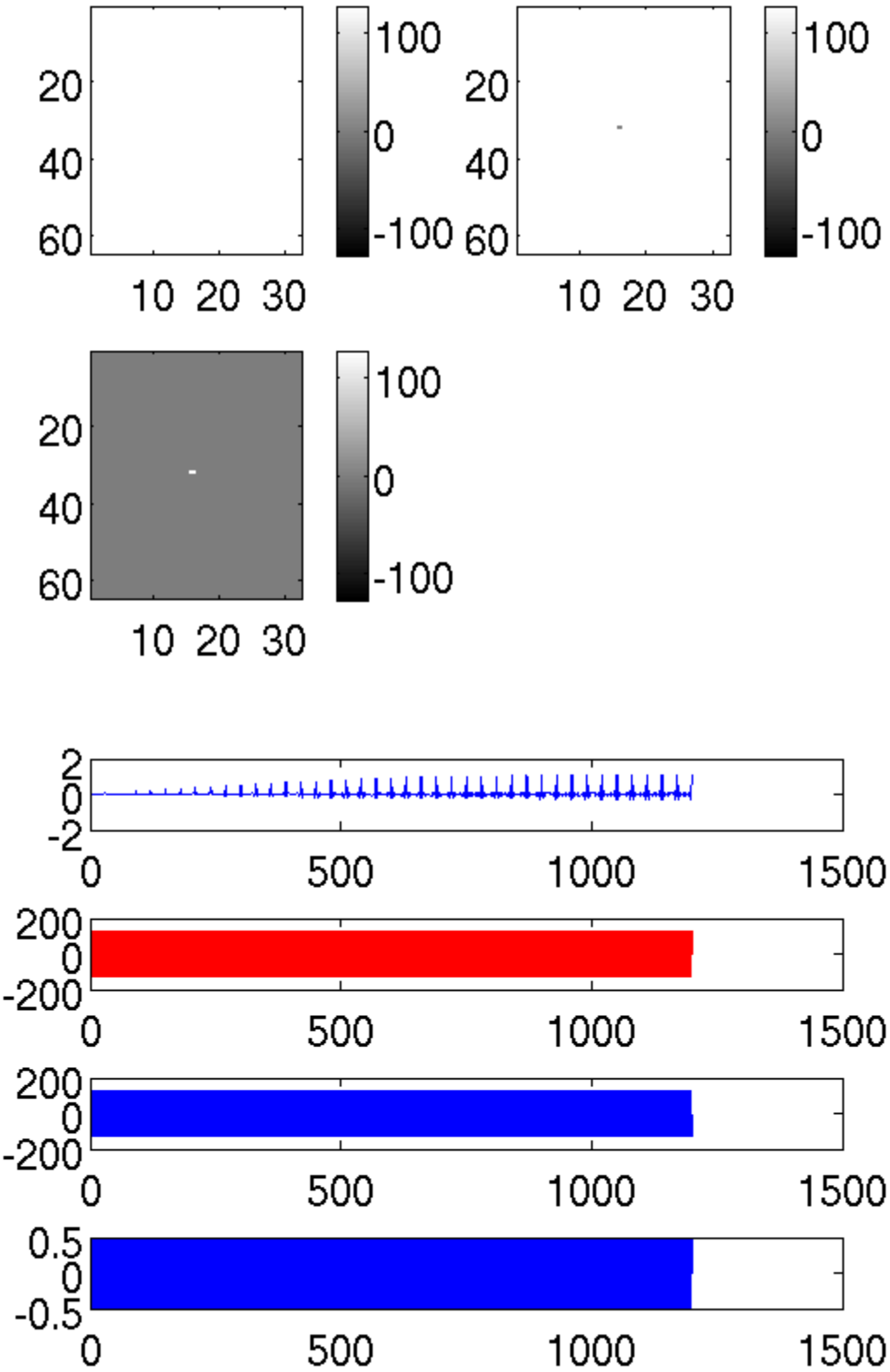
```
momentum=0.7;

%  LSQR - Solve , change it to CRAIG when that starts working!
damp=0;
atol=10^-9;
btol=10^-9;
conlim=1.0e+300; % Doubt!
itnlim=1000;
show=1;

tic;
[ x, istop, itn, r1norm, r2norm, Anorm, Acond, Arnorm, xnorm, var ]...
   = lsqrSOL( movie_time*n_cell, movie_time*filt_dim1*filt_dim2, @dual_AAtx2, b(:)
toc;

mov_modify_new=reshape(x,[filt_dim1,filt_dim2,movie_time])+mov;
res=norm(Ax(stas,mov_modify_new,movie_time,n_cell))
mov_modify_new = mov_modify_new*127.5/max(abs(mov_modify_new(:)));
%
figure;
for itime=1:10

subplot(2,2,1);
imagesc(mov(:,:,itime));
colormap gray
colorbar
caxis([-127.5,127.5]);

subplot(2,2,2);
imagesc(mov_modify_new(:,:,itime));
colormap gray
colorbar
caxis([-127.5,127.5]);

subplot(2,2,3);
imagesc(mov(:,:,itime)-mov_modify_new(:,:,itime));
colormap gray
colorbar
caxis([-127.5,127.5]);

pause(0.1);
end

figure;
subplot(4,1,1);
ax=reshape(mov_modify_new(32,16,:),[1200,1]);
plot(ax)
subplot(4,1,2);
ax=reshape(mov_modify_new(33,16,:),[1200,1]);
plot(ax,'r')
subplot(4,1,3)
ax= reshape(mov_modify_new(32,16,:)-mov(32,16,:),[1200,1]);
plot(ax);
subplot(4,1,4)
```

```
ax= reshape(mov_modify_new(50,32,:)-mov(50,32,:),[1200,1]);
plot(ax);
```

```
LSQR            Least-squares solution of  Ax = b
The matrix A has     1200 rows  and 2.4576e+06 cols
damp = 0.00000000000000e+00    wantvar =        1
atol = 1.00e-09                 conlim = 1.00e+300
btol = 1.00e-09                 itnlim =     1000

   Itn      x(1)       r1norm     r2norm  Compatible   LS      Norm A   Co
     0  0.00000e+00  1.309e+05  1.309e+05   1.0e+00  2.3e-04
     1  0.00000e+00  5.543e+03  5.543e+03   4.2e-02  6.9e-01  3.0e+01  1.0
     2  0.00000e+00  2.635e+03  2.635e+03   2.0e-02  4.1e-01  3.8e+01  2.1
     3  0.00000e+00  1.668e+03  1.668e+03   1.3e-02  3.0e-01  4.4e+01  3.3
     4  0.00000e+00  1.189e+03  1.189e+03   9.1e-03  2.4e-01  4.9e+01  4.8
     5  0.00000e+00  9.055e+02  9.055e+02   6.9e-03  2.0e-01  5.3e+01  6.4
     6  0.00000e+00  7.197e+02  7.197e+02   5.5e-03  1.7e-01  5.8e+01  8.1
     7  0.00000e+00  5.905e+02  5.905e+02   4.5e-03  1.5e-01  6.1e+01  1.0
     8  0.00000e+00  4.968e+02  4.968e+02   3.8e-03  1.3e-01  6.5e+01  1.2
     9  0.00000e+00  4.263e+02  4.263e+02   3.3e-03  1.2e-01  6.8e+01  1.4
    10  0.00000e+00  3.714e+02  3.714e+02   2.8e-03  1.1e-01  7.2e+01  1.6
    20  0.00000e+00  1.442e+02  1.442e+02   1.1e-03  5.7e-02  9.8e+01  4.4
    30  0.00000e+00  8.031e+01  8.031e+01   6.1e-04  3.9e-02  1.2e+02  7.8
    40  0.00000e+00  5.058e+01  5.058e+01   3.9e-04  2.6e-02  1.3e+02  1.2
    50  0.00000e+00  3.613e+01  3.613e+01   2.8e-04  2.3e-02  1.5e+02  1.7
    60  0.00000e+00  2.787e+01  2.787e+01   2.1e-04  2.0e-02  1.6e+02  2.2
    70  0.00000e+00  2.198e+01  2.198e+01   1.7e-04  1.5e-02  1.8e+02  2.7
    80  0.00000e+00  1.416e+01  1.416e+01   1.1e-04  1.4e-02  1.8e+02  3.7
    90  0.00000e+00  1.087e+01  1.087e+01   8.3e-05  8.6e-03  2.0e+02  4.8
   100  0.00000e+00  9.227e+00  9.227e+00   7.0e-05  5.4e-03  2.1e+02  5.7
   110  0.00000e+00  8.312e+00  8.312e+00   6.3e-05  1.2e-02  2.2e+02  6.5
   120  0.00000e+00  7.521e+00  7.521e+00   5.7e-05  6.1e-03  2.3e+02  7.5
   130  0.00000e+00  6.824e+00  6.824e+00   5.2e-05  9.5e-03  2.4e+02  8.5
   140  0.00000e+00  6.188e+00  6.188e+00   4.7e-05  7.8e-03  2.5e+02  9.5
   150  0.00000e+00  5.484e+00  5.484e+00   4.2e-05  8.7e-03  2.5e+02  1.1
   160  0.00000e+00  4.792e+00  4.792e+00   3.7e-05  7.4e-03  2.6e+02  1.2
   170  0.00000e+00  4.236e+00  4.236e+00   3.2e-05  5.7e-03  2.7e+02  1.3
   180  0.00000e+00  3.791e+00  3.791e+00   2.9e-05  8.9e-03  2.8e+02  1.5
   190  0.00000e+00  3.477e+00  3.477e+00   2.7e-05  3.6e-03  2.8e+02  1.6
   200  0.00000e+00  3.138e+00  3.138e+00   2.4e-05  5.9e-03  2.9e+02  1.7
   210  0.00000e+00  2.854e+00  2.854e+00   2.2e-05  6.4e-03  3.0e+02  1.8
   220  0.00000e+00  2.643e+00  2.643e+00   2.0e-05  5.5e-03  3.1e+02  1.9
   230  0.00000e+00  2.389e+00  2.389e+00   1.8e-05  7.1e-03  3.1e+02  2.1
   240  0.00000e+00  2.183e+00  2.183e+00   1.7e-05  6.0e-03  3.2e+02  2.2
   250  0.00000e+00  2.036e+00  2.036e+00   1.6e-05  5.1e-03  3.2e+02  2.3
   260  0.00000e+00  1.900e+00  1.900e+00   1.5e-05  4.7e-03  3.3e+02  2.5
   270  0.00000e+00  1.793e+00  1.793e+00   1.4e-05  3.0e-03  3.4e+02  2.6
   280  0.00000e+00  1.685e+00  1.685e+00   1.3e-05  2.4e-03  3.4e+02  2.7
   290  0.00000e+00  1.620e+00  1.620e+00   1.2e-05  2.0e-03  3.5e+02  2.9
   300  0.00000e+00  1.571e+00  1.571e+00   1.2e-05  2.1e-03  3.5e+02  3.0
   310  0.00000e+00  1.509e+00  1.509e+00   1.2e-05  3.1e-03  3.6e+02  3.1
   320  0.00000e+00  1.450e+00  1.450e+00   1.1e-05  2.8e-03  3.7e+02  3.3
   330  0.00000e+00  1.394e+00  1.394e+00   1.1e-05  5.1e-03  3.7e+02  3.4
```

340	0.00000e+00	1.328e+00	1.328e+00	1.0e-05	4.2e-03	3.8e+02	3.6
350	0.00000e+00	1.278e+00	1.278e+00	9.8e-06	2.5e-03	3.8e+02	3.8
360	0.00000e+00	1.220e+00	1.220e+00	9.3e-06	2.8e-03	3.9e+02	4.0
370	0.00000e+00	1.170e+00	1.170e+00	8.9e-06	2.6e-03	3.9e+02	4.2
380	0.00000e+00	1.088e+00	1.088e+00	8.3e-06	1.9e-03	4.0e+02	4.5
390	0.00000e+00	1.020e+00	1.020e+00	7.8e-06	3.3e-03	4.0e+02	4.7
400	0.00000e+00	9.651e-01	9.651e-01	7.4e-06	2.3e-03	4.1e+02	4.9
410	0.00000e+00	9.158e-01	9.158e-01	7.0e-06	4.3e-03	4.1e+02	5.1
420	0.00000e+00	8.613e-01	8.613e-01	6.6e-06	2.4e-03	4.2e+02	5.3
430	0.00000e+00	8.212e-01	8.212e-01	6.3e-06	3.2e-03	4.2e+02	5.5
440	0.00000e+00	7.837e-01	7.837e-01	6.0e-06	2.5e-03	4.3e+02	5.7
450	0.00000e+00	7.531e-01	7.531e-01	5.8e-06	3.0e-03	4.3e+02	5.9
460	0.00000e+00	7.180e-01	7.180e-01	5.5e-06	2.2e-03	4.4e+02	6.1
470	0.00000e+00	6.992e-01	6.992e-01	5.3e-06	2.1e-03	4.4e+02	6.2
480	0.00000e+00	6.759e-01	6.759e-01	5.2e-06	1.7e-03	4.5e+02	6.4
490	0.00000e+00	6.511e-01	6.511e-01	5.0e-06	2.2e-03	4.5e+02	6.6
500	0.00000e+00	6.290e-01	6.290e-01	4.8e-06	1.5e-03	4.6e+02	6.8
510	0.00000e+00	6.089e-01	6.089e-01	4.7e-06	1.1e-03	4.6e+02	7.0
520	0.00000e+00	5.893e-01	5.893e-01	4.5e-06	1.0e-03	4.7e+02	7.3
530	0.00000e+00	5.703e-01	5.703e-01	4.4e-06	1.4e-03	4.7e+02	7.5
540	0.00000e+00	5.505e-01	5.505e-01	4.2e-06	1.3e-03	4.8e+02	7.7
550	0.00000e+00	5.365e-01	5.365e-01	4.1e-06	2.3e-03	4.8e+02	7.9
560	0.00000e+00	5.174e-01	5.174e-01	4.0e-06	1.4e-03	4.8e+02	8.2
570	0.00000e+00	5.044e-01	5.044e-01	3.9e-06	1.1e-03	4.9e+02	8.4
580	0.00000e+00	4.934e-01	4.934e-01	3.8e-06	2.8e-03	4.9e+02	8.6
590	0.00000e+00	4.799e-01	4.799e-01	3.7e-06	2.7e-03	5.0e+02	8.8
600	0.00000e+00	4.669e-01	4.669e-01	3.6e-06	1.2e-03	5.0e+02	9.1
610	0.00000e+00	4.563e-01	4.563e-01	3.5e-06	1.2e-03	5.1e+02	9.3
620	0.00000e+00	4.458e-01	4.458e-01	3.4e-06	1.2e-03	5.1e+02	9.5
630	0.00000e+00	4.350e-01	4.350e-01	3.3e-06	8.2e-04	5.1e+02	9.7
640	0.00000e+00	4.238e-01	4.238e-01	3.2e-06	1.3e-03	5.2e+02	1.0
650	0.00000e+00	4.160e-01	4.160e-01	3.2e-06	1.5e-03	5.2e+02	1.0
660	0.00000e+00	4.090e-01	4.090e-01	3.1e-06	1.3e-03	5.3e+02	1.0
670	0.00000e+00	4.009e-01	4.009e-01	3.1e-06	1.9e-03	5.3e+02	1.1
680	0.00000e+00	3.928e-01	3.928e-01	3.0e-06	9.4e-04	5.3e+02	1.1
690	0.00000e+00	3.836e-01	3.836e-01	2.9e-06	7.4e-04	5.4e+02	1.1
700	0.00000e+00	3.756e-01	3.756e-01	2.9e-06	8.6e-04	5.4e+02	1.1
710	0.00000e+00	3.628e-01	3.628e-01	2.8e-06	1.2e-03	5.4e+02	1.2
720	0.00000e+00	3.497e-01	3.497e-01	2.7e-06	3.2e-03	5.5e+02	1.2
730	0.00000e+00	3.375e-01	3.375e-01	2.6e-06	2.9e-03	5.5e+02	1.2
740	0.00000e+00	3.272e-01	3.272e-01	2.5e-06	3.0e-03	5.6e+02	1.3
750	0.00000e+00	3.192e-01	3.192e-01	2.4e-06	1.7e-03	5.6e+02	1.3
760	0.00000e+00	3.101e-01	3.101e-01	2.4e-06	7.9e-04	5.6e+02	1.3
770	0.00000e+00	3.026e-01	3.026e-01	2.3e-06	1.6e-03	5.7e+02	1.3
780	0.00000e+00	2.958e-01	2.958e-01	2.3e-06	1.6e-03	5.7e+02	1.4
790	0.00000e+00	2.889e-01	2.889e-01	2.2e-06	1.7e-03	5.7e+02	1.4
800	0.00000e+00	2.834e-01	2.834e-01	2.2e-06	6.8e-04	5.8e+02	1.4
810	0.00000e+00	2.783e-01	2.783e-01	2.1e-06	9.2e-04	5.8e+02	1.4
820	0.00000e+00	2.738e-01	2.738e-01	2.1e-06	7.5e-04	5.9e+02	1.5
830	0.00000e+00	2.703e-01	2.703e-01	2.1e-06	9.9e-04	5.9e+02	1.5
840	0.00000e+00	2.676e-01	2.676e-01	2.0e-06	8.6e-04	5.9e+02	1.5
850	0.00000e+00	2.627e-01	2.627e-01	2.0e-06	1.4e-03	6.0e+02	1.5
860	0.00000e+00	2.589e-01	2.589e-01	2.0e-06	7.8e-04	6.0e+02	1.5
870	0.00000e+00	2.555e-01	2.555e-01	2.0e-06	1.5e-03	6.0e+02	1.6

```
   880  0.00000e+00  2.513e-01  2.513e-01   1.9e-06  1.0e-03  6.1e+02  1.6
   890  0.00000e+00  2.474e-01  2.474e-01   1.9e-06  1.3e-03  6.1e+02  1.6
   900  0.00000e+00  2.443e-01  2.443e-01   1.9e-06  7.8e-04  6.1e+02  1.6
   910  0.00000e+00  2.413e-01  2.413e-01   1.8e-06  1.2e-03  6.2e+02  1.7
   920  0.00000e+00  2.376e-01  2.376e-01   1.8e-06  7.4e-04  6.2e+02  1.7
   930  0.00000e+00  2.344e-01  2.344e-01   1.8e-06  1.1e-03  6.2e+02  1.7
   940  0.00000e+00  2.306e-01  2.306e-01   1.8e-06  1.3e-03  6.3e+02  1.8
   950  0.00000e+00  2.269e-01  2.269e-01   1.7e-06  9.0e-04  6.3e+02  1.8
   960  0.00000e+00  2.229e-01  2.229e-01   1.7e-06  1.2e-03  6.3e+02  1.8
   970  0.00000e+00  2.192e-01  2.192e-01   1.7e-06  1.0e-03  6.4e+02  1.8
   980  0.00000e+00  2.163e-01  2.163e-01   1.7e-06  7.7e-04  6.4e+02  1.9
   990  0.00000e+00  2.126e-01  2.126e-01   1.6e-06  4.9e-04  6.4e+02  1.9
   991  0.00000e+00  2.123e-01  2.123e-01   1.6e-06  1.8e-03  6.4e+02  1.9
   992  0.00000e+00  2.115e-01  2.115e-01   1.6e-06  8.5e-04  6.4e+02  1.9
   993  0.00000e+00  2.110e-01  2.110e-01   1.6e-06  1.0e-03  6.4e+02  1.9
   994  0.00000e+00  2.108e-01  2.108e-01   1.6e-06  8.1e-04  6.4e+02  1.9
   995  0.00000e+00  2.105e-01  2.105e-01   1.6e-06  1.2e-03  6.4e+02  1.9
   996  0.00000e+00  2.103e-01  2.103e-01   1.6e-06  4.9e-04  6.5e+02  1.9
   997  0.00000e+00  2.102e-01  2.102e-01   1.6e-06  1.1e-03  6.5e+02  1.9
   998  0.00000e+00  2.091e-01  2.091e-01   1.6e-06  1.9e-03  6.5e+02  1.9
   999  0.00000e+00  2.087e-01  2.087e-01   1.6e-06  1.3e-03  6.5e+02  1.9
  1000  0.00000e+00  2.083e-01  2.083e-01   1.6e-06  5.0e-04  6.5e+02  1.9

lsqrSOL finished
The iteration limit has been reached

istop =       7   r1norm = 2.1e-01   Anorm = 6.5e+02   Arnorm = 6.8e-02
itn   =    1000   r2norm = 2.1e-01   Acond = 1.9e+04   xnorm  = 4.4e+03

Elapsed time is 775.021094 seconds.

res =

    0.2083
```


20
40
60
10 20 30
100
0
-100
20
40
60
10 20 30
100
0
-100
20
40
60
10 20 30
100
0
-100
2
0
-2
0 500 1000 1500
200
0
-200
0 500 1000 1500
200
0
-200
0 500 1000 1500
0.5
0
-0.5
0 500 1000 1500

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