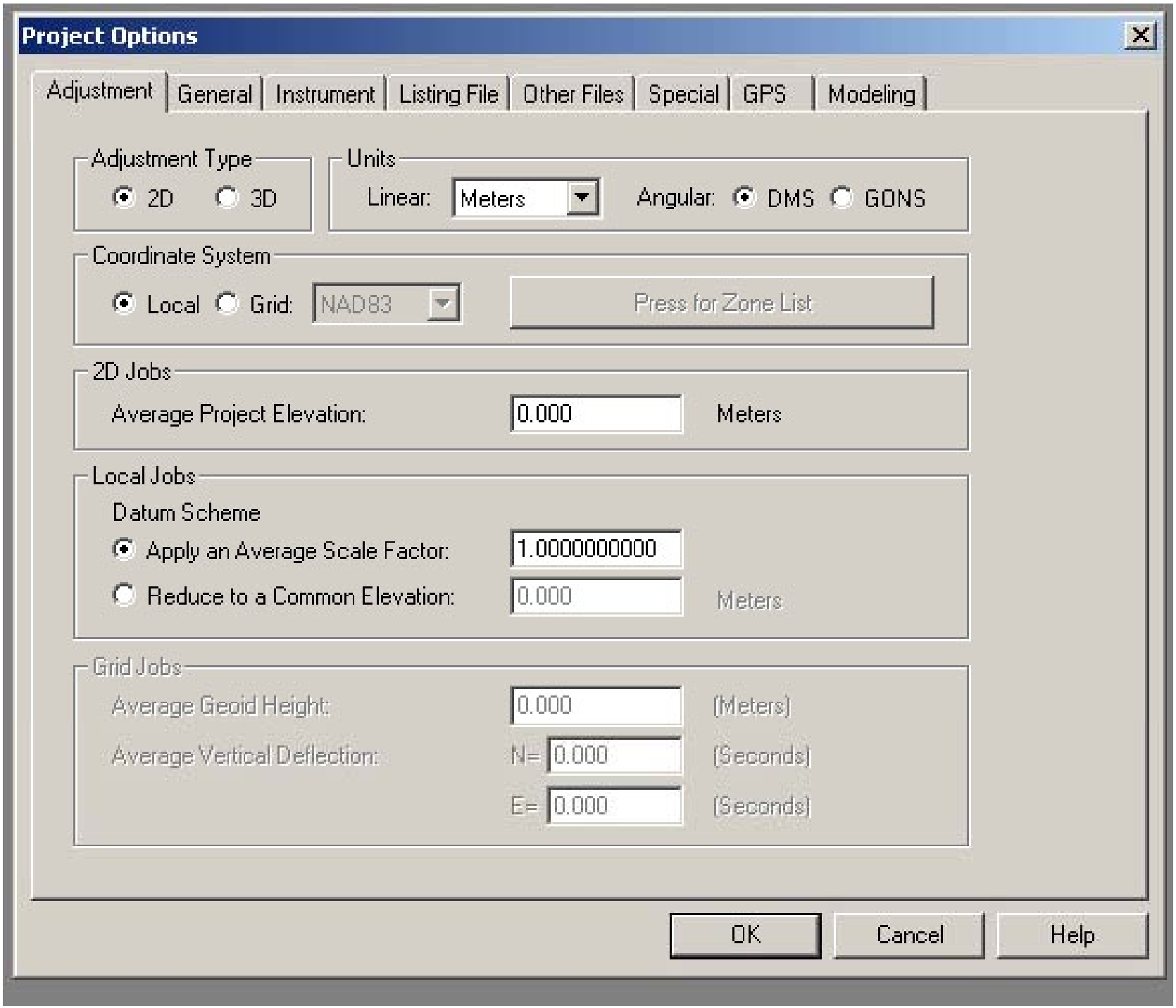
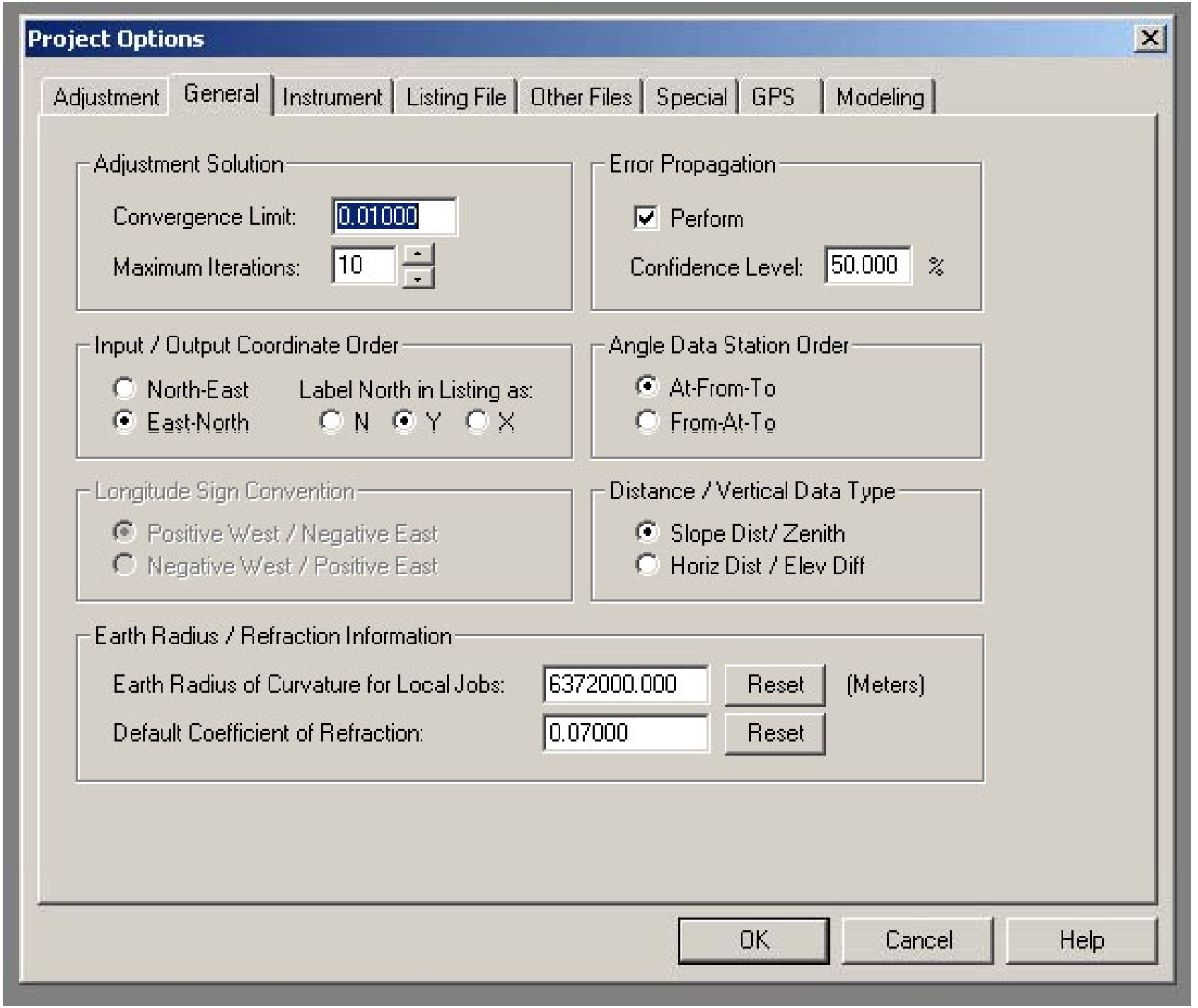
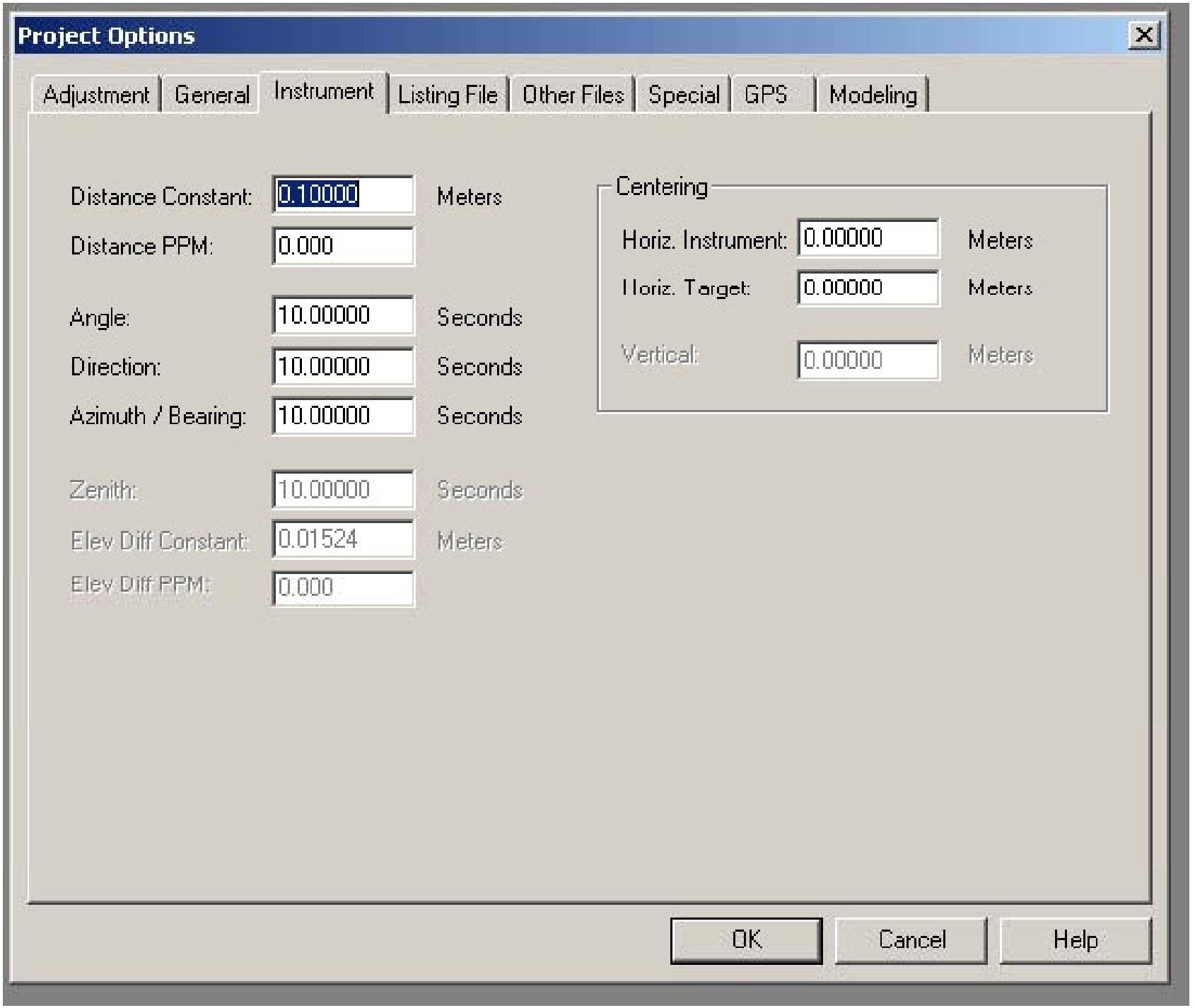
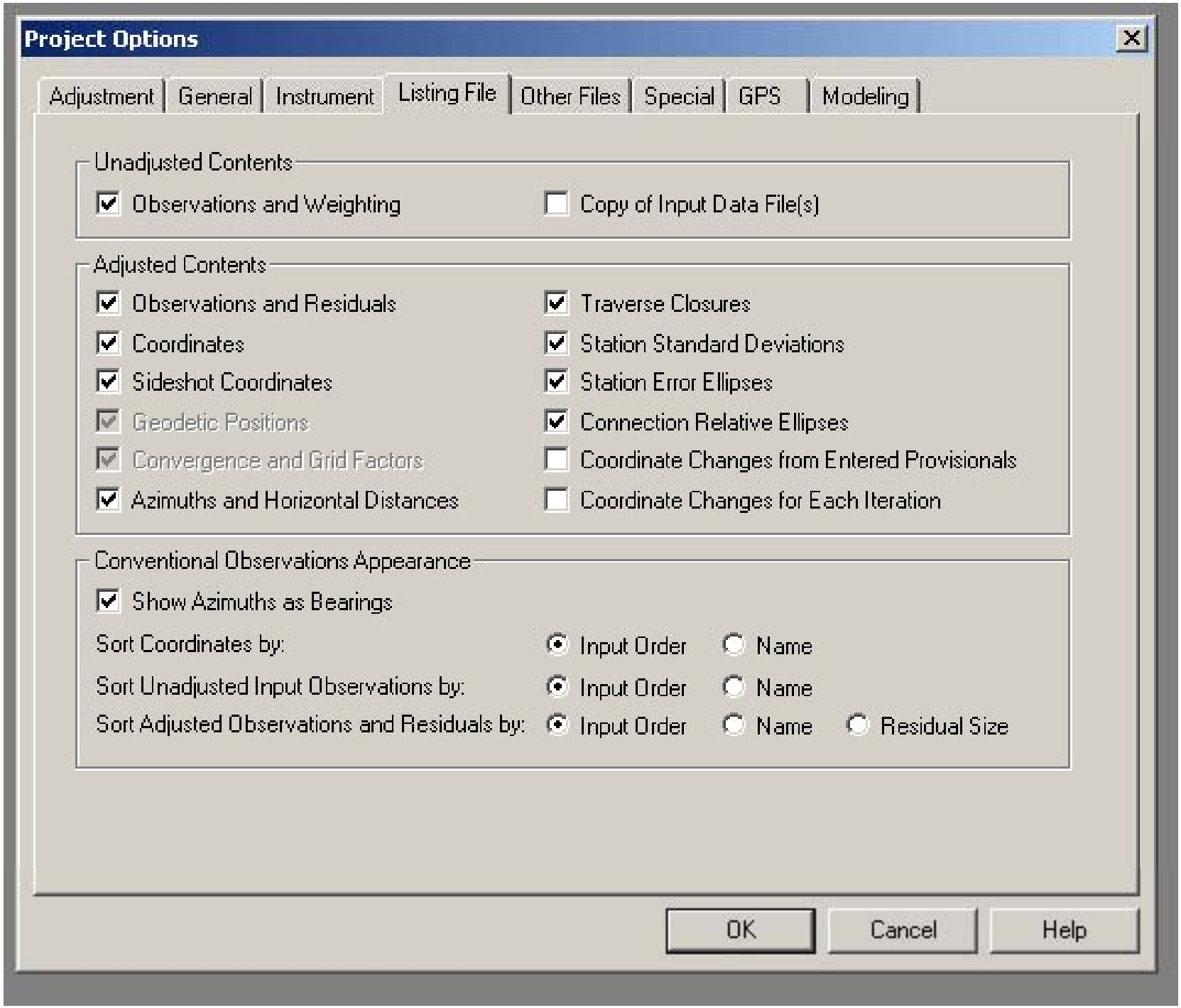
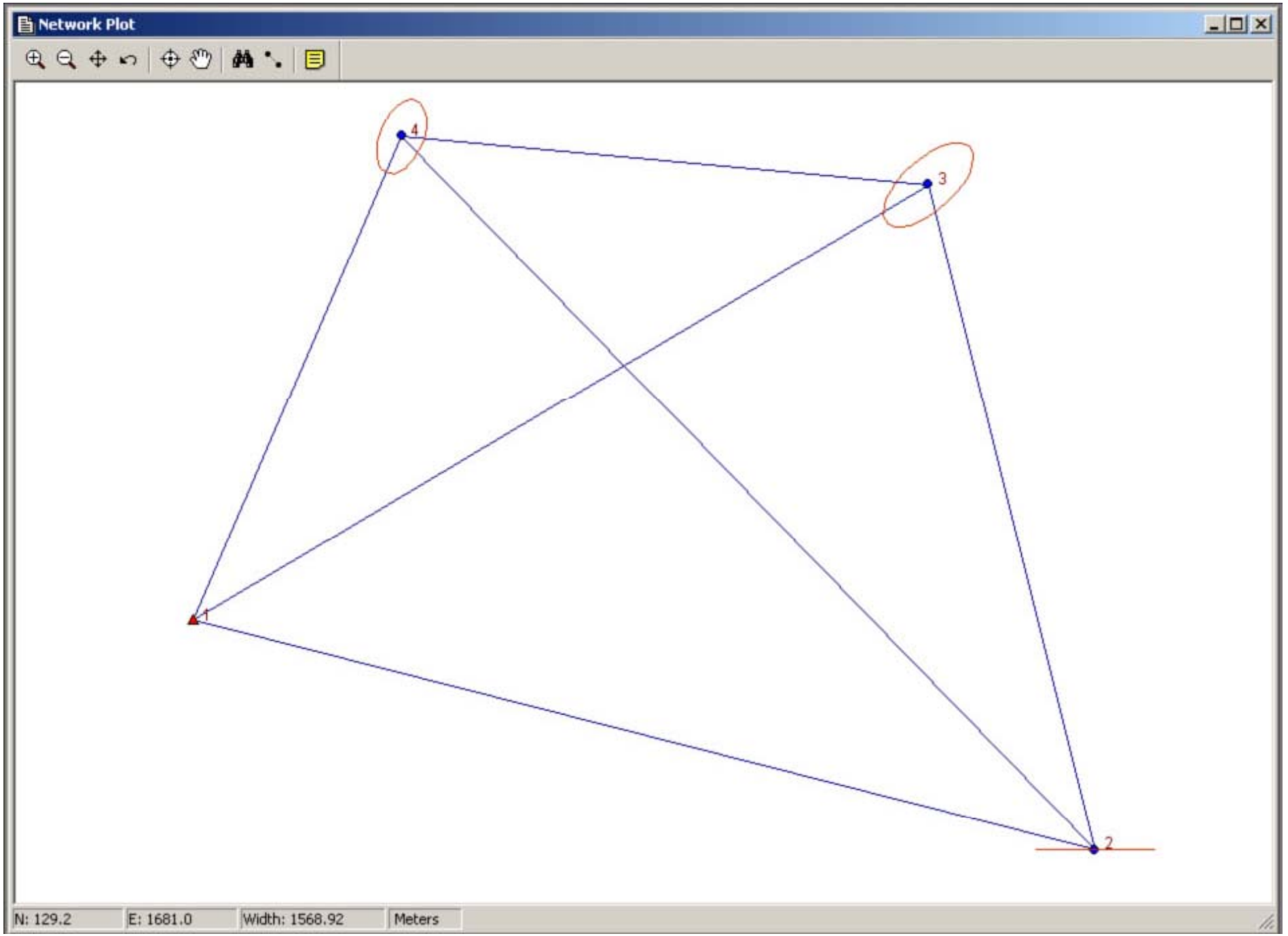

Project Options
Adjustment
General
Instrument
Listing File
Other Files
Special
GPS
Modeling
Adjustment Type
2D
3D
Units
Linear:
Meters
Angular:
DMS
GONS
Coordinate System
Local
Grid:
NAD83
Press for Zone List
2D Jobs
Average Project Elevation:
0.000
Meters
Local Jobs
Datum Scheme
Apply an Average Scale Factor:
1.0000000000
Reduce to a Common Elevation:
0.000
Meters
Grid Jobs
Average Geoid Height:
0.000
(Meters)
Average Vertical Deflection:
N=
0.000
(Seconds)
E=
0.000
(Seconds)
OK
Cancel
Help


Project Options
Adjustment
General
Instrument
Listing File
Other Files
Special
GPS
Modeling
Adjustment Solution
Convergence Limit:
0.01000
Maximum Iterations:
10
Error Propagation
Perform
Confidence Level:
50.000
%
Input / Output Coordinate Order
North-East
East-North
Label North in Listing as:
N
Y
X
Angle Data Station Order
At-From-To
From-At-To
Longitude Sign Convention
Positive West / Negative East
Negative West / Positive East
Distance / Vertical Data Type
Slope Dist/ Zenith
Horiz Dist / Elev Diff
Earth Radius / Refraction Information
Earth Radius of Curvature for Local Jobs:
6372000.000
Reset
(Meters)
Default Coefficient of Refraction:
0.07000
Reset
OK
Cancel
Help


Project Options
Adjustment
General
Instrument
Listing File
Other Files
Special
GPS
Modeling
Distance Constant:
0.10000
Meters
Distance PPM:
0.000
Angle:
10.00000
Seconds
Direction:
10.00000
Seconds
Azimuth / Bearing:
10.00000
Seconds
Zenith:
10.00000
Seconds
Elev Diff Constant:
0.01524
Meters
Elev Diff PPM:
0.000
Centering
Horiz. Instrument:
0.00000
Meters
Horiz. Target:
0.00000
Meters
Vertical:
0.00000
Meters
OK
Cancel
Help


Project Options
Adjustment
General
Instrument
Listing File
Other Files
Special
GPS
Modeling
Unadjusted Contents
Observations and Weighting
Copy of Input Data File(s)
Adjusted Contents
Observations and Residuals
Coordinates
Sideshot Coordinates
Geodetic Positions
Convergence and Grid Factors
Azimuths and Horizontal Distances
Traverse Closures
Station Standard Deviations
Station Error Ellipses
Connection Relative Ellipses
Coordinate Changes from Entered Provisionals
Coordinate Changes for Each Iteration
Conventional Observations Appearance
Show Azimuths as Bearings
Sort Coordinates by:
Input Order
Name
Sort Unadjusted Input Observations by:
Input Order
Name
Sort Adjusted Observations and Residuals by:
Input Order
Name
Residual Size
OK
Cancel
Help


Network Plot
4
3
1
2
N: 129.2
E: 1681.0
Width: 1568.92
Meters

```
# braced quadrilateral
# hw4 fall 2008 adjustment course
C    1    362.000    415.000    !  !
C    2   1488.000    129.000    *  !
C    3   1280.000    960.000    *  *
C    4    622.000   1020.000    *  *
# angles at-from-to
A    1-3-2      44-56-50     10
A    2-1-4      31-33-42     10
A    2-4-3      30-07-48     10
A    3-2-1      73-21-19     10
A    3-1-4      35-54-30     10
A    4-3-2      40-36-14     10
A    4-2-1      67-26-31     10
A    1-4-3      36-02-50     10
# distances
D    1-2        1161.80      0.10
D    3-4         660.69      0.10
```

braced_quad.lst
STAR*NET-DEMO Version 6.0.14
Copyright 1988-2000 Starplus Software, Inc.
Licensed for Demo Use Only
Run Date: Wed Dec 03 2008 22:08:24

Summary of Files Used and Option Settings

Project Folder and Data Files

Project Name BRACED_QUAD
Project Folder C:\DATA\CLASSES\DATA1_08\SN6
Data File List braced_quad.dat

Project Option Settings

STAR*NET Run Mode	: Adjust with Error Propagation
Type of Adjustment	: 2D
Project Units	: Meters; DMS
Coordinate System	: LOCAL
Default Project Elevation	: 0.0000 Meters
Apply Average Scale Factor	: 1.0000000000
Input/Output Coordinate Order	: East-North (Shown as X-Y)
Angle Data Station Order	: At-From-To
Distance/Vertical Data Type	: Slope/Zenith
Convergence Limit; Max Iterations	: 0.0100; 10
Default Coefficient of Refraction	: 0.0700
Earth Radius	: 6372000.00 Meters
Create Coordinate File	: Yes
Create Ground Scale Coordinate File	: No
Create Dump File	: No

Instrument Standard Error Settings

Project Default Instrument

Distances (Constant)	:	0.10000 Meters
Distances (PPM)	:	0.00000
Angles	:	10.00000 Seconds
Directions	:	10.00000 Seconds
Azimuths & Bearings	:	10.00000 Seconds
Centering Error Instrument	:	0.00000 Meters
Centering Error Target	:	0.00000 Meters

Summary of Unadjusted Input Observations

Number of Entered Stations (Meters) = 4

Fixed Stations	X	Y	Description
1	362.0000	415.0000	
Partially Fixed	**X**	**Y**	**Description**
	StdErr	StdErr	
2	1488.0000	129.0000	
	FREE	FIXED	
Free Stations	**X**	**Y**	**Description**
3	1280.0000	960.0000	
4	622.0000	1020.0000	

Number of Angle Observations (DMS) = 8

At	From	To	Angle	StdErr
1	3	2	44-56-50.00	10.00
2	1	4	31-33-42.00	10.00
2	4	3	30-07-48.00	10.00
3	2	1	73-21-19.00	10.00
3	1	4	35-54-30.00	10.00
4	3	2	40-36-14.00	10.00
4	2	1	67-26-31.00	10.00
1	4	3	36-02-50.00	10.00

Number of Distance Observations (Meters) = 2

From	To	Distance	StdErr
1	2	1161.8000	0.1000
3	4	660.6900	0.1000

Adjustment Statistical Summary

Convergence Iterations = 3

Number of Stations = 4

Number of Observations = 10
Number of Unknowns = 5
Number of Redundant Obs = 5

Observation	Count	Sum Squares of StdRes	Error Factor
Angles	8	1.37	0.59
Distances	2	0.14	0.37
Total	10	1.51	0.55

Adjustment Passed the Chi Square Test at 5% Level

Adjusted Coordinates (Meters)

Station	X	Y	Description
1	362.0000	415.0000	
2	1488.0287	129.0000	
3	1279.9996	960.0041	
4	622.0078	1020.0091	

Adjusted Observations and Residuals

Adjusted Angle Observations (DMS)

At	From	To	Angle	Residual	StdErr	StdRes
1	3	2	44-56-53.65	0-00-03.65	10.00	0.4
2	1	4	31-33-48.94	0-00-06.94	10.00	0.7
2	4	3	30-07-51.29	0-00-03.29	10.00	0.3
3	2	1	73-21-26.11	0-00-07.11	10.00	0.7
3	1	4	35-54-27.60	-0-00-02.40	10.00	0.2
4	3	2	40-36-14.99	0-00-00.99	10.00	0.1
4	2	1	67-26-28.43	-0-00-02.57	10.00	0.3
1	4	3	36-02-48.97	-0-00-01.03	10.00	0.1

Adjusted Distance Observations (Meters)

From	To	Distance	Residual	StdErr	StdRes

1	2	1161.7817	-0.0183	0.1000	0.2
3	4	660.7222	0.0322	0.1000	0.3

Adjusted Bearings (DMS) and Horizontal Distances (Meters)

(Relative Confidence of Bearing is in Seconds)

From	To	Bearing	Distance	50% RelConfidence Brg	Dist	PPM
1	2	S75-44-55.68E	1161.7817	4.67	0.1037	89.2331
1	3	N59-18-10.67E	1067.5920	9.64	0.1006	94.2160
1	4	N23-15-21.70E	658.5136	12.35	0.0715	108.5614
2	3	N14-03-15.44W	856.6469	12.86	0.0856	99.9316
2	4	N44-11-06.73W	1242.5335	9.02	0.1134	91.2318
3	4	N84-47-21.73W	660.7222	12.73	0.0650	98.4365

Error Propagation

Station Coordinate Standard Deviations (Meters)

Station	X	Y
1	0.00000	0.00000
2	0.09084	0.00000
3	0.06980	0.06496
4	0.03853	0.05765

Station Coordinate Error Ellipses (Meters)

Confidence Region = 50%

Station	Semi-Major Axis	Semi-Minor Axis	Azimuth of Major Axis
1	0.00000	0.00000	0-00
2	0.10696	0.00000	90-00
3	0.10211	0.04668	48-09
4	0.07150	0.03941	22-07

Relative Error Ellipses (Meters)

Confidence Region = 50%

Stations From	To	Semi-Major Axis	Semi-Minor Axis	Azimuth of Major Axis
1	2	0.10696	0.00000	90-00
1	3	0.10211	0.04668	48-09
1	4	0.07150	0.03941	22-07
2	3	0.09222	0.04094	141-25
2	4	0.11801	0.04331	118-26
3	4	0.06636	0.03858	81-05

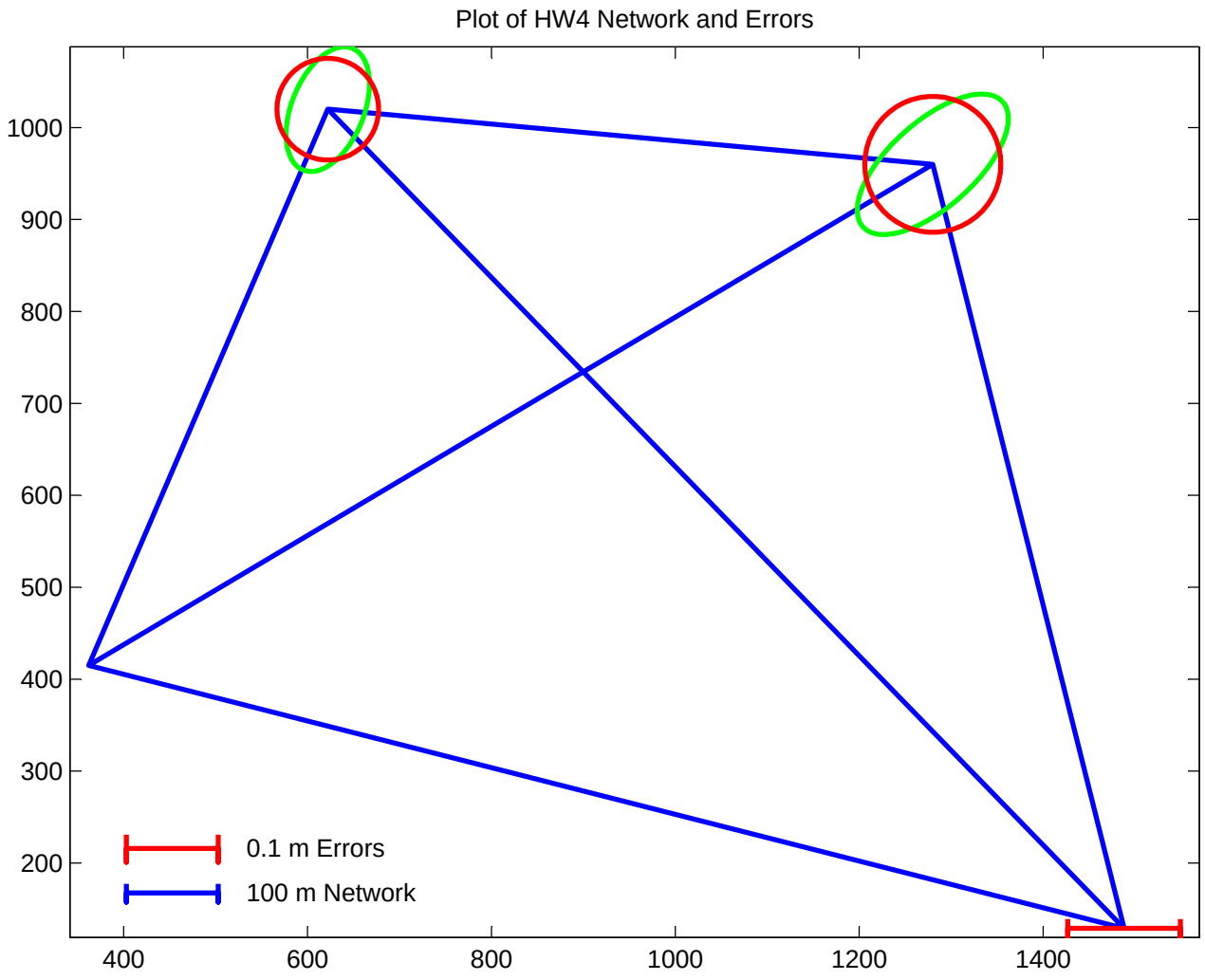
Elapsed Time = 00:00:00

```
03 00000057 Free Coordinates
02 00000061 Angle Observations
02 00000073 Distance Observations
01 00000079 Adjustment Statistical Summary
01 00000099 Adjusted Coordinates
01 00000108 Adjusted Observations and Residuals
02 00000111 Adjusted Angle Observations
02 00000123 Adjusted Distance Observations
01 00000129 Adjusted Bearings and Horizontal Distances
01 00000142 Error Propagation
02 00000145 Station Coordinate Standard Deviations
02 00000153 Station Coordinate Error Ellipses
02 00000163 Relative Error Ellipses
01 00000174 End of File
00001FF3
STARPLUS
00011633
```

```
*STAR*NET 2
#
# 6.0.14
#
#
[Adjustment]
#
adjustment_type                 2D
linear_units                    Meters
angle_output_units              DMS
local_or_grid_adjustment        0
coordinate_projection           0
coordinate_zone                 0
coordinate_zone_name            LOCAL
coordinate_ellipsoid_name       GRS-80
utm_hemisphere                  N
project_elevation               0.000000000000000
local_default_datum             1
common_datum_reduction          0.0000000000
scale_factor                    1.0000000000
geoid_height                    0.000000
vert_defl_north                 0.000000
vert_defl_east                  0.000000
coordinate_order                EN
coordinate_order_north          Y
angle_station_order             At-From-To
3D_input_mode                   Slope/Zenith
index_of_refraction             0.0700000000
earth_radius_meters             6372000.0000000000
converge_limit                  0.0100000000
maximum_iterations              10
perform_error_propagation       1
ell_percent_confidence          50.0000
longitude_convention            0
geoid_modeling                  0
geoid_file_select               0
vert_defl_modeling              0
vert_defl_file_select           0
gps_factor                      0
gps_factor_alt_vert             0
gps_factor_horiz                1.000000
gps_factor_vert                 1.000000
gps_centering                   0
gps_centering_alt_vert          0
gps_centering_horiz             0.000000
gps_centering_vert              0.000000
gps_transformations             0
gps_transform_type              0
gps_transform_scale             0
gps_transform_scale_flag        0
gps_transform_scale_value       1.000000000000000
gps_transform_rotations         0
gps_transform_nrot              0
gps_transform_nrot_flag         0
gps_transform_nrot_value        0.0000000000
gps_transform_erot              0
gps_transform_erot_flag         0
gps_transform_erot_value        0.0000000000
gps_transform_urot              0
gps_transform_urot_flag         0
gps_transform_urot_value        0.0000000000
gps_vector_serial_id            1
#
```

```
#
[Listing]
#
print_input_file               0
list_observations              1
list_adj_obs_residuals         1
list_adj_dist_az               1
list_converge                  1
list_traverses                 1
list_coordinates               1
list_positions                 1
list_sideshot_coordinates      1
show_coord_changes             0
coord_changes_from_entered     0
list_bearing                   1
list_standard_deviations       1
list_station_ellipses          1
list_relative_ellipses         1
sort_coordinates               0
sort_unadjusted_observations   0
sort_adjusted_observations     0
create_coordinate_file         1
coordinate_output_script       Default
create_position_file           0
create_ground_scale_file       0
ground_output_script           Default
grnd_file_grid_enable          1
grnd_file_grid_type            0
grnd_file_grid_factor_local    1.000000000000000
grnd_file_grid_factor          1.000000000000000
grnd_file_rotation_enable      0
grnd_file_rotation_type        1
grnd_file_rotation_azimuth     0.0000000000
grnd_file_rotation_rotation    0.0000000000
grnd_file_trans_enable         0
grnd_file_trans_type           1
grnd_file_trans_use_coord      1
grnd_file_trans_northing       0.0000000000
grnd_file_trans_easting        0.0000000000
number_coord_decimals          4
number_position_decimals       6
number_elevation_decimals      4
create_dump_file               0
dump_rel_connections           0
list_geoid_model               1
list_vdef_model                1
gps_weight_method              0
gps_sort_unadjusted_vectors    0
gps_sort_adjusted_vectors      0
gps_enable_residual_summary    0
gps_residual_summary           0
gps_enable_ecef_values         0
gps_earth_centered_values      0
pos_tolerance_check            0
pos_tolerance_value_meters     0.030480
pos_tolerance_ppm              0.000000
pos_tolerance_confidence       95.000000
pos_tolerance_list_type        0
#
#
[Instrument]
#
distance_std_err               0.1000000000
```

```
edm_ppm                         0.0000000000
angle_std_err                   10.0000000000
direction_std_err               10.0000000000
azimuth_std_err                 10.0000000000
zenith_std_err                  10.0000000000
delta_elev_std_err              0.0152400305
delta_elev_ppm                  0.0000000000
instrument_centering_error      0.0000000000
target_centering_error          0.0000000000
vertical_centering_error        0.0000000000
#
#
[DataFileList]
#
3 "braced_quad.dat"
#
#
[Plot]
#
plot_net_show_name              1
plot_net_show_desc              0
plot_net_show_mark              1
plot_net_show_ellipse           1
plot_net_show_rel_ellipse       0
plot_ss_show_sideshot           1
plot_ss_show_name               1
plot_ss_show_desc               0
plot_ss_show_mark               1
plot_size_text                  100
plot_size_symbol                60
plot_ellipse_exaggeration       684
plot_draw_transparent_text      1
plot_draw_while_wnd_size_move   1
plot_draw_extent_frame          0
plot_meters_per_pixel           15.2274830000
plot_view_origin_x              925.0143690000
plot_view_origin_y              574.5045550000
plot_view_max_x                 1747.2776410000
plot_view_max_y                 1085.8168970000
plot_view_min_x                 102.7510980000
plot_view_min_y                 61.1564200000
plot_scale                      1.0000000000
plot_zoom_bottom_right_x        1747.2776410000
plot_zoom_bottom_right_y        61.1564200000
plot_zoom_top_left_x            102.7510980000
plot_zoom_top_left_y            1085.8168970000
plot_draw_all_station_ellipses  0
plot_draw_only_fixed_stations   0
#
#
[DXF]
#
dxf_transfer_elevations         0
dxf_transfer_relative_ellipses  0
dxf_transfer_ellipses           0
dxf_lettering_size              0.1000000000
dxf_lettering_slant             0.0000000000
dxf_symbol_size                 0.1000000000
dxf_drawing_scale               100.0000000000
#
#
```


Plot of HW4 Network and Errors
1000
900
800
700
600
500
400
300
200
400
600
800
1000
1200
1400
0.1 m Errors
100 m Network

```
hw4_sol
iter =
     1
del2 =
         -1.89415684189726
        0.0706716863808907
          9.90762724808921
         0.160670064301669
          17.8901557133893
iter =
     2
del2 =
       -0.0770961849185834
       -0.0710482918856273
        0.0964279856432816
        -0.152823426638568
         0.118950398714267
iter =
     3
del2 =
     -8.0846609478936e-006
      -6.009063744709e-006
     9.78256042853996e-008
    -1.28880405901892e-005
     3.96893022911463e-006
iter =
     4
del2 =
    -2.15551351600252e-010
    -1.68691572267367e-010
    -6.29881741991511e-011
     3.10312010982249e-011
    -7.65696856632695e-011
convergence OK
v =
       -0.0182989896972755
         0.032176052428398
     1.77158384131451e-005
     3.36623489349303e-005
     1.59587444920282e-005
     3.44739411929667e-005
    -1.16140020500218e-005
     4.81454766477143e-006
    -1.24431114440428e-005
     -4.9981182258614e-006
vdms =
                         0
                         0
           3.65415397779224
vdms =
                         0
                         0
           6.94335788088555
vdms =
                         0
                         0
            3.2917273405951
vdms =
                         0
                         0
           7.11076080074107
vdms =
                         0
```

consistent with StarNet v6 solution

```
                         0
         -2.39555988260112
vdms =
                         0
                         0
          0.993071741241489
vdms =
                         0
                         0
         -2.56657597111652
vdms =
                         0
                         0
         -1.03093588745738
final coordinates
P =
                       362
                       415
          1488.02873888831
                       129
          1279.99961738526
          960.004055331495
          622.007833749654
          1020.00911008096
post adj statistics - 2-sided F-test alpha 0.05
test_stat =
          1.51038001397748
cv1 =
          0.831211613486663
cv2 =
            12.83250199403
we pass
Sdd =
  Columns 1 through 3
                         0                         0                         0
                         0                         0                         0
                         0                         0       0.00825268523817354
                         0                         0                         0
                         0                         0       0.00500037010347704
                         0                         0       0.00535762814806167
                         0                         0      0.000831147666065795
                         0                         0       0.00453476129926905
  Columns 4 through 6
                         0                         0                         0
                         0                         0                         0
                         0       0.00500037010347704       0.00535762814806167
                         0                         0                         0
                         0       0.00487251922298519       0.00295652421177116
                         0       0.00295652421177116       0.00421964481275128
                         0       0.00161536406154951      0.000206593151309748
                         0       0.00332313980132341       0.00320959907218344
  Columns 7 through 8
                         0                         0
                         0                         0
      0.000831147666065796       0.00453476129926905
                         0                         0
       0.00161536406154951       0.00332313980132341
      0.000206593151309748       0.00320959907218344
       0.00148438640298363      0.000895493931244048
      0.000895493931244048       0.00332362819454014
cov3 =
       0.00487251922298519       0.00295652421177116
       0.00295652421177116       0.00421964481275128
```

```
eigvec =
         0.744897834791554        -0.667178548608133
         0.667178548608133         0.744897834791554
eigval =
       0.00752057301023544                         0
                         0       0.00157159102550103
axlen3 =
         0.102106454039301                         0
axlen3 =
         0.102106454039301        0.0466764156361508
theta3 =
         0.730414629025776
CE_radius_3 =
        0.0739916387096958
eigvec =
        -0.926402324554458        -0.376535168424008
         0.376535168424008        -0.926402324554458
eigval =
       0.00112041391577531                         0
                         0       0.00368760068174846
axlen4 =
         0.0714989512592301                         0
axlen4 =
         0.0714989512592301        0.0394109565166791
theta4 =
        -1.95684967364084
CE_radius_4 =
        0.0553448800169284
half_intvl2 =
        0.0612735432579704
n =
    50
n =
    50
diary off
```

```
% hw4_sol.m  3-nov-08
% solve braced quad for hw4

X=[362;1490;1280;622];
Y=[415;129;950;1002];
P=[X(1); Y(1); X(2); Y(2); X(3); Y(3); X(4); Y(4)];
degrad=180/pi;
n=10;
n0=5;
r=5;
u=n0;
sigd=0.10;
siga=(10/3600)/degrad;
sd2=sigd^2;
sa2=siga^2;
sigma0_sqr=1;
w=[1/sd2 1/sd2 1/sa2 1/sa2 1/sa2 1/sa2 1/sa2 1/sa2 1/sa2 1/sa2];
W=diag(w);
d=[1161.80;660.69];
th=zeros(8,1);
th(1)=(44+56/60+50/3600)/degrad;
th(2)=(31+33/60+42/3600)/degrad;
th(3)=(30+07/60+48/3600)/degrad;
th(4)=(73+21/60+19/3600)/degrad;
th(5)=(35+54/60+30/3600)/degrad;
th(6)=(40+36/60+14/3600)/degrad;
th(7)=(67+26/60+31/3600)/degrad;
th(8)=(36+02/60+50/3600)/degrad;
% first 2 are distances, next 8 are angles
at=  [1 3 1 2 2 3 3 4 4 1];
from=[0 0 3 1 4 2 1 3 2 4];
to=  [2 4 2 4 3 1 4 2 1 3];
pidx=[1 3 5 7];

keep_going=1;
iter=0;
while(keep_going == 1)
  iter=iter+1
  B=zeros(n,u);
  f=zeros(n,1);
  rwidx=0;
  for i=1:2
    rwidx=rwidx+1;
    rs=distance2d(d(i),at(i),to(i),X,Y);
    B(rwidx,pidx(at(i)))  =rs(2);
    B(rwidx,pidx(at(i))+1)=rs(3);
    B(rwidx,pidx(to(i)))  =rs(4);
    B(rwidx,pidx(to(i))+1)=rs(5);
    f(rwidx)=-rs(1);
    end

  for i=1:8
    rwidx=rwidx+1;
    rs=angle2d(th(i),at(i+2),from(i+2),to(i+2),X,Y);
    B(rwidx,pidx(at(i+2)))    =rs(2);
    B(rwidx,pidx(at(i+2))+1)  =rs(3);
    B(rwidx,pidx(from(i+2)))  =rs(4);
    B(rwidx,pidx(from(i+2))+1)=rs(5);
    B(rwidx,pidx(to(i+2)))    =rs(6);
    B(rwidx,pidx(to(i+2))+1)  =rs(7);
    f(rwidx)=-rs(1);
    end
```

```
  B2=elim_col(B,[1 2 4]);
  N2=B2'*W*B2;
  t2=B2'*W*f;
  del2=inv(N2)*t2
  del=ins_zerv(del2,[1 2 4]);
  P=P+del;
  Ni2=inv(N2);
  Qdd2=Ni2;
  Qdd=ins_zerm(Qdd2,[1 2 4]);
  X=[P(1) P(3) P(5) P(7)];
  Y=[P(2) P(4) P(6) P(8)];
  if(all(abs(del2) < 0.00001))
    keep_going=0;
    disp('convergence OK');
    end
  if(iter > 10)
    keep_going=0;
    disp('failed to converge');
    end
  end

v=f-B2*del2
for i=3:10
  vdms=raddms(v(i))
  end

disp('final coordinates');
P

% ok now post-adjustment statistics

disp('post adj statistics - 2-sided F-test alpha 0.05');
test_stat=v'*W*v/1.0
cv1=icdf('chi2',0.025,r)
cv2=icdf('chi2',0.975,r)
if((test_stat > cv1) & (test_stat < cv2))
  pass=1;
  disp('we pass');
  Sdd=sigma0_sqr*Qdd
  % first point 3
  cov3=Sdd(5:6,5:6)
  [eigvec,eigval]=eig(cov3)
  major_axis=1;
  minor_axis=2;
  lambda1=eigval(1,1);
  lambda2=eigval(2,2);
  if(lambda2 > lambda1)
    major_axis=2;
    minor_axis=1;
    lambda1=eigval(2,2);
    lambda2=eigval(1,1);
    end
  axlen3=zeros(1,2);
  P=0.5;
  axlen3(1)=sqrt(eigval(major_axis,major_axis)*icdf('chi2',P,2))
  axlen3(2)=sqrt(eigval(minor_axis,minor_axis)*icdf('chi2',P,2))
  majr3=eigvec(:,major_axis)*axlen3(1);
  minr3=eigvec(:,minor_axis)*axlen3(2);
  theta3=atan2(majr3(2),majr3(1))
  % get 50% CE
  CE_radius_3=cep2(P,cov3)
  % next point 4
  cov4=Sdd(7:8,7:8);
```

```
  [eigvec,eigval]=eig(cov4)
  major_axis=1;
  minor_axis=2;
  lambda1=eigval(1,1);
  lambda2=eigval(2,2);
  if(lambda2 > lambda1)
    major_axis=2;
    minor_axis=1;
    lambda1=eigval(2,2);
    lambda2=eigval(1,1);
    end
  axlen4=zeros(1,2);
  P=0.5;
  axlen4(1)=sqrt(eigval(major_axis,major_axis)*icdf('chi2',P,2))
  axlen4(2)=sqrt(eigval(minor_axis,minor_axis)*icdf('chi2',P,2))
  majr4=eigvec(:,major_axis)*axlen4(1);
  minr4=eigvec(:,minor_axis)*axlen4(2);
  theta4=atan2(majr4(2),majr4(1))
  % get 50% CE
  CE_radius_4=cep2(P,cov4)
  % next confidence interval for X2
  varX2=Sdd(3,3);
  stdX2=sqrt(varX2);
  alpha=1-P;
  z=icdf('norm',1-alpha/2,0,1);
  half_intvl2=z*stdX2

else
  disp('we do not pass');
  pass=0;
  sigma0_sqr_hat=v'*W*v/r;
  Sdd=sigma0_sqr_hat*Qdd
  % first point 3
  cov3=Sdd(5:6,5:6)
  [eigvec,eigval]=eig(cov3)
  major_axis=1;
  minor_axis=2;
  lambda1=eigval(1,1);
  lambda2=eigval(2,2);
  if(lambda2 > lambda1)
    major_axis=2;
    minor_axis=1;
    lambda1=eigval(2,2);
    lambda2=eigval(1,1);
    end
  axlen3=zeros(1,2);
  P=0.5;
  axlen3(1)=sqrt(eigval(major_axis,major_axis)*2*icdf('f',P,2,r))
  axlen3(2)=sqrt(eigval(minor_axis,minor_axis)*2*icdf('f',P,2,r))
  majr3=eigvec(:,major_axis)*axlen3(1);
  minr3=eigvec(:,minor_axis)*axlen3(2);
  theta3=atan2(majr3(2),majr3(1))
  % get 50% CE
  CE_radius_3=cep2(P,cov3)
  % next point 4
  cov4=Sdd(7:8,7:8);
  [eigvec,eigval]=eig(cov4)
  major_axis=1;
  minor_axis=2;
  lambda1=eigval(1,1);
  lambda2=eigval(2,2);
  if(lambda2 > lambda1)
    major_axis=2;
```

```
    minor_axis=1;
    lambda1=eigval(2,2);
    lambda2=eigval(1,1);
    end
  axlen4=zeros(1,2);
  P=0.5;
  axlen4(1)=sqrt(eigval(major_axis,major_axis)*2*icdf('f',P,2,r))
  axlen4(2)=sqrt(eigval(minor_axis,minor_axis)*2*icdf('f',P,2,r))
  majr4=eigvec(:,major_axis)*axlen4(1);
  minr4=eigvec(:,minor_axis)*axlen4(2);
  theta4=atan2(majr4(2),majr4(1))
  % get 50% CE
  CE_radius_4=cep2(P,cov4)
  % next confidence interval for X2
  varX2=Sdd(3,3);
  stdX2=sqrt(varX2);
  alpha=1-P;
  tt=icdf('t',1-alpha/2,r);
  half_intvl2=ttstdX2
  end

% plot the network

plot([X(1) X(2) X(3) X(4) X(1) X(3)],[Y(1) Y(2) Y(3) Y(4) Y(1)
Y(3)],'b-','linewidth',2);
hold on
plot([X(2) X(4)],[Y(2) Y(4)],'b-','linewidth',2);
err_factor=1000;
% plot errors point 3
a=axlen3(1)*err_factor;
b=axlen3(2)*err_factor;
theta=theta3;
rd=CE_radius_3*err_factor;
rs=draw_ell(X(3),Y(3),a,b,theta);
rs=draw_cir(X(3),Y(3),rd);
% plot errors point 4
a=axlen4(1)*err_factor;
b=axlen4(2)*err_factor;
theta=theta4;
rd=CE_radius_4*err_factor;
rs=draw_ell(X(4),Y(4),a,b,theta);
rs=draw_cir(X(4),Y(4),rd);
halfbar=half_intvl2*err_factor;
tick=10;
barx1=X(2) - halfbar;
barx2=X(2) + halfbar;
bary1=Y(2);
bary2=Y(2);
pxvec=[barx1 barx1 barx1 barx2 barx2 barx2];
pyvec=[bary1+tick bary1-tick bary2 bary2 bary2-tick bary2+tick];
plot(pxvec,pyvec,'r-','linewidth',2);

% proper aspect ratio
axis equal

lmt=axis;
xrange=lmt(2)-lmt(1);
yrange=lmt(4)-lmt(3);
x5pct=0.05*xrange;
y5pct=0.05*yrange;
% network scale bar
barx1=lmt(1) + x5pct;
bary1=lmt(3) + y5pct;
```

```
barx2=barx1 + 100;
bary2=bary1;
tick=10;
pxvec=[barx1 barx1 barx1 barx2 barx2 barx2];
pyvec=[bary1+tick bary1-tick bary2 bary2 bary2-tick bary2+tick];
plot(pxvec,pyvec,'b-','linewidth',2);
textx=barx2 + 0.5*x5pct;
texty=bary2;
text(textx,texty,'100 m Network');
% error scale bar
barx1=lmt(1) + x5pct;
bary1=lmt(3) + 2*y5pct;
barx2=barx1 + 0.1*err_factor;
bary2=bary1;
tick=15;
pxvec=[barx1 barx1 barx1 barx2 barx2 barx2];
pyvec=[bary1+tick bary1-tick bary2 bary2 bary2-tick bary2+tick];
plot(pxvec,pyvec,'r-','linewidth',2);
textx=barx2 + 0.5*x5pct;
texty=bary2;
text(textx,texty,'0.1 m Errors');

title('Plot of HW4 Network and Errors');
```

```
% angle2d.m  3-nov-08
function result = angle2d(a,i,j,k,X,Y)
xi=X(i);
yi=Y(i);
xj=X(j);
yj=Y(j);
xk=X(k);
yk=Y(k);
Dij_sq=(xj-xi)^2 + (yj-yi)^2;
Dik_sq=(xk-xi)^2 + (yk-yi)^2;
dFdxi= (yk-yi)/Dik_sq - (yj-yi)/Dij_sq;
dFdyi=-(xk-xi)/Dik_sq + (xj-xi)/Dij_sq;
dFdxj=(yj-yi)/Dij_sq;
dFdyj=-(xj-xi)/Dij_sq;
dFdxk=-(yk-yi)/Dik_sq;
dFdyk=(xk-xi)/Dik_sq;
ac=atan2(xk-xi,yk-yi) - atan2(xj-xi,yj-yi);
if(ac < 0)
  ac=ac + 2*pi;
  end

% ac
% degrad=180/pi;
% ac*degrad

Fa=a - ac;
result=[Fa dFdxi dFdyi dFdxj dFdyj dFdxk dFdyk];
```

```
% cep2.m 11-nov-04
% for given 2x2 covariance and probability P,
% compute radius yielding P under bivariate normal
% syntax res=cep2(P,cov);
% original in d:\classes\ce603_03\

function res=cep2(P,cov)
sx2=cov(1,1);
sy2=cov(2,2);
sxy=cov(1,2);
sx=sqrt(sx2);
sy=sqrt(sy2);
long=max([sx sy]);
dr=long/50;
t1=2*pi*sqrt(det(cov));
term1=1/t1;
covi=inv(cov);
X=zeros(2,1);
degrad=180/(pi);
dth=1/degrad;
nth=180;
accumP=0;
rr=0;
while(accumP < 0.5*P)
rp=rr + 0.5*dr;
tt=0;
for j=1:nth
thp=tt + 0.5*dth;
X(1)=rp*cos(thp);
X(2)=rp*sin(thp);
term2=-0.5*(X'*covi*X);
f=term1*exp(term2);
dens=f;
%mu=[0 0];
%XX=[X(1) X(2)];
%dens=mvnpdf(XX,mu,cov);
da=rp*dth*dr;
accumP=accumP + da*dens;
tt=tt + dth;
end
rr=rr + dr;
end
res=rr;
```

```
% distance2d.m  3-nov-08
function result = distance2d(d,i,j,X,Y)
xi=X(i);
yi=Y(i);
xj=X(j);
yj=Y(j);
Dij=sqrt((xj-xi)^2 + (yj-yi)^2);
dFdxi=(xj-xi)/Dij;
dFdyi=(yj-yi)/Dij;
dFdxj=-dFdxi;
dFdyj=-dFdyi;
Fd=d - Dij;
result=[Fd dFdxi dFdyi dFdxj dFdyj];
```

```
% draw_cir.m  13-oct-08
function result=draw_cir(x0,y0,r)
xi=x0+r;
yi=y0;
n=50
degrad=180/pi;
dth=2*pi/n;
rth=0;
for i=1:n
  rth=rth+dth;
  costh=cos(rth);
  sinth=sin(rth);
  xip1=x0 + r*costh;
  yip1=y0 + r*sinth;
  plot([xi xip1],[yi yip1],'r','linewidth',2);
  if(i==2)
    hold on
    end
  xi=xip1;
  yi=yip1;
  end
result=0;
```

```
% draw_ell.m  22-oct-08
% function to draw ellipse

function result=draw_ell(xorg,yorg,a,b,theta)

th=theta;
x0=a;
y0=0;
nseg=50;
dalpha=2*pi/nseg;
for i=1:nseg
  alpha=i*dalpha;
  x1=a*cos(alpha);
  y1=b*sin(alpha);
  px0=xorg + cos(th)*x0 - sin(th)*y0;
  py0=yorg + sin(th)*x0 + cos(th)*y0;
  px1=xorg + cos(th)*x1 - sin(th)*y1;
  py1=yorg + sin(th)*x1 + cos(th)*y1;
  plot([px0 px1],[py0 py1],'-g','linewidth',2);
  if(i == 1)
    hold on
    end
  x0=x1;
  y0=y1;
  end
result=0;
```

```
% elim_col.m  8-nov-04
% eliminate a list of columns from a matrix

function Bnew = elim_col(B,col_list);
[m,n]=size(B);
[p,q]=size(col_list);
nelim=max([p q]);
newcol=n-nelim;
if(newcol<1)
  disp('trying to eliminate too many columns');
  pause
  end

Bnew=zeros(m,newcol);
ii=1;
for i=1:n
  ok=1;
  for j=1:nelim
    if(col_list(j) == i)
      ok=0;
      end
    end

  if(ok == 1)
    Bnew(:,ii)=B(:,i);
    ii=ii+1;
    end
  end
```

```
% ins_zerm.m  8-nov-04
% insert zero rows & cols into a square matrix

function Ni3 = ins_zerm(Ni,col_list);
[m,n]=size(Ni);
orig_size=m;
[p,q]=size(col_list);
nadd=max([p q]);
newdim=orig_size + nadd;

Ni2=zeros(newdim,orig_size);

% first the rows
ii=1;
for i=1:newdim
  ins=0;
  for j=1:nadd
    if(col_list(j) == i)
      ins=1;
      end
    end

  if(ins == 1)
    Ni2(i,:)=zeros(1,orig_size);
  else
    Ni2(i,:)=Ni(ii,:);
    ii=ii+1;
    end
  end

Ni3=zeros(newdim,newdim);

% now the cols
ii=1;
for i=1:newdim
  ins=0;
  for j=1:nadd
    if(col_list(j) == i)
      ins=1;
      end
    end

  if(ins == 1)
    Ni3(:,i)=zeros(newdim,1);
  else
    Ni3(:,i)=Ni2(:,ii);
    ii=ii+1;
    end
  end
```

```
% ins_zerv.m  8-nov-04
% insert zeros into a vector

function del2 = ins_zerv(del,col_list);
[m,n]=size(del);
orig_size=max([m n]);
[p,q]=size(col_list);
nadd=max([p q]);
newdim=orig_size + nadd;

del2=zeros(newdim,1);
ii=1;
for i=1:newdim
  ins=0;
  for j=1:nadd
    if(col_list(j) == i)
      ins=1;
      end
    end

  if(ins == 1)
    del2(i)=0;
  else
    del2(i)=del(ii);
    ii=ii+1;
    end

  end
```

```
% raddms.m  25-sep-08
% function to convert an angle in radians
% to degrees, minutes, and seconds

function dms=raddms(angrad)
degrad=180/pi;
angdeg=angrad*degrad;
deg=fix(angdeg);
frac=angdeg-deg;
rmin=frac*60;
min=fix(rmin);
frac=rmin-min;
sec=frac*60;
dms=[deg;min;sec];
```