Problem 18.1

This homework carries 125 points where 25 points are considered extra credit

Standard deviation Computation of coordinates E and F is an extra credit (25 points)

**PROBLEMS**

*Note:* For problems requiring least squares adjustment, if a computer program

is not distinctly specified for use in the problem, it is expected that the least

squares algorithm will be solved using the program MATRIX, which is available

on the book’s companion website. Partial answers to problems marked

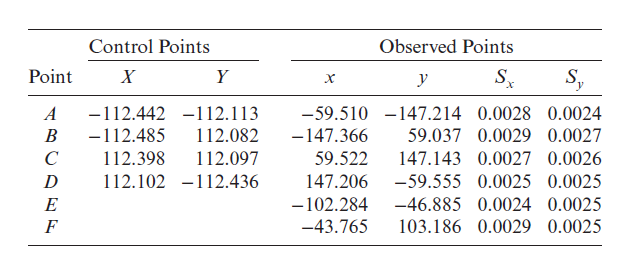
with an asterisk are given in Appendix H.

**18.1** Points *A*, *B*, *C*, and *D* have their coordinates known in both an *XY* system and a *xy* system. Points *E* and *F* have their coordinates knownonly in the *xy* system. These coordinates are shown in the table below.Using a two-dimensional conformal coordinate transformation,determine the

**\*(a)** Transformation parameters and their standard deviations.

**(b)** Most probable coordinates and their standard deviations for *E* and *F* in the *XY* coordinate system.

**\*(c)** Rotation angle and scale factor.



% %Conformal Transformation class example

% Note: For problems requiring least squares adjustment, if a computer program

% is not distinctly specified for use in the problem, it is expected that the least

% squares algorithm will be solved using the program MATRIX, which is available

% on the book’s companion website. Partial answers to problems marked

% with an asterisk are given in Appendix H.

% 18.1 Points A, B, C, and D have their coordinates known in both an XY system and a xy system. Points E and F have their coordinates known only in the xy system. These coordinates are shown in the table below. Using a two-dimensional conformal coordinate transformation, determine the

% \*(a) Transformation parameters and their standard deviations.

% (b) Most probable coordinates and their standard deviations for E and F in the XY coordinate system.

% \*(c) Rotation angle and scale factor.

% X +? X = ax ? by + c

% Y +? Y = bx + ay + d

% Control point coordinates in EN

close all

clc

clear all

EN=[-112.442 -112.113;

-112.485 112.082;

112.398 112.097;

112.102 -112.436;]

% Control point coordinates in xy

xy=[-59.510 -147.214;

-147.366 59.037;

59.522 147.143;

147.206 -59.555]

% Form Observation matrix

A=[xy(1,1) -xy(1,2) 1 0;

xy(1,2) xy(1,1) 0 1;

xy(2,1) -xy(2,2) 1 0;

xy(2,2) xy(2,1) 0 1;

xy(3,1) -xy(3,2) 1 0;

xy(3,2) xy(3,1) 0 1;

xy(4,1) -xy(4,2) 1 0;

xy(4,2) xy(4,1) 0 1;]

L=[EN(1,1);EN(1,2);EN(2,1);EN(2,2);EN(3,1); EN(3,2);EN(4,1);EN(4,2)]

% Parameters a-d

X=inv(A'\*A)\*A'\*L

%Residual

V=A\*X-L

% Reference Standard deviation

S0=sqrt(V'\*V/4)

% precision of adjusted parameters

Q=inv(A'\*A)

std\_X=S0\*sqrt(diag(Q))

% rotation

theta=atand(X(2)/X(1))

theta=theta+180

% Scale

S=sqrt(X(1)^2+X(2)^2)

%Convert additional points in xy CS to EN CS

% aditional xy

xya=[-102.284 -46.885;

-43.765 103.186;]

Aad=[xya(1,1) -xya(1,2) 1 0;

xya(1,2) xya(1,1) 0 1;

xya(2,1) -xya(2,2) 1 0;

xya(2,2) xya(2,1) 0 1;]

ENa=Aad\*X

%Error propagation in EN coordinate of 1-4

Var\_ENa=Aad\*Q\*Aad'

std\_ENa=sqrt(diag(Var\_ENa))

**Below this line is contained the answer.**

EN =

-112.4420 -112.1130

-112.4850 112.0820

112.3980 112.0970

112.1020 -112.4360

xy =

-59.5100 -147.2140

-147.3660 59.0370

59.5220 147.1430

147.2060 -59.5550

A =

-59.5100 147.2140 1.0000 0

-147.2140 -59.5100 0 1.0000

-147.3660 -59.0370 1.0000 0

59.0370 -147.3660 0 1.0000

59.5220 -147.1430 1.0000 0

147.1430 59.5220 0 1.0000

147.2060 59.5550 1.0000 0

-59.5550 147.2060 0 1.0000

L =

-112.4420

-112.1130

-112.4850

112.0820

112.3980

112.0970

112.1020

-112.4360

X =

0.9201

-0.3918

-0.0150

0.0285

V =

-0.0011

-0.0002

0.0031

-0.0011

-0.0017

0.0032

-0.0003

-0.0018

S0 =

0.0027

Q =

0.0000 -0.0000 0.0000 0.0000

-0.0000 0.0000 -0.0000 0.0000

0.0000 -0.0000 0.2500 0.0000

0.0000 0.0000 0.0000 0.2500

std\_X =

0.0000

0.0000

0.0013

0.0013

theta =

-23.0625

theta =

156.9375

S =

1.0000

xya =

-102.2840 -46.8850

-43.7650 103.1860

Aad =

-102.2840 46.8850 1.0000 0

-46.8850 -102.2840 0 1.0000

-43.7650 -103.1860 1.0000 0

103.1860 -43.7650 0 1.0000

ENa =

-112.4962

-3.0414

0.1392

112.1173

Var\_ENa =

0.3754 0.0000 0.2464 -0.1251

-0.0000 0.3754 0.1251 0.2464

0.2464 0.1251 0.3749 -0.0000

-0.1251 0.2464 0.0000 0.3749

std\_ENa =

0.6127

0.6127

0.6123

0.6123

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