Scilab Textbook Companion for Surveying Volume 3 by A. K. Arora[1]

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Book Description

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Scilab numbering policy used in this document and the relation to the above book.

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

AP Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

Contents

List of Scilab Codes

Chapter 1

Electronic Distance Measurement

Scilab code Exa 1.1 1

```
1
2  clc; funcprot(0);
3  // Initialization of Variable
4  T=273+25.0;//temperature in K
5  p=752.0;//pressure mm Hg
6  No=294.0e-6;
7  ns=1.000284;
8  D1=1438.254;//recorded distance in m
9  h=263.42-243.25;//height difference in m
10 R=6370e3;//radius of earth in m
11 //calculation
12 n=1+No*(273/T)*(p/760);
13 D=D1*ns/n;
14 cg=-h**2/2/D;
15 Hm=263.42/2+243.25/2;
16 D=D+cg;
17 ch=-D*Hm/R
18 EL=D+ch;
19 disp(EL,"equivalent length in m")
```

```
20 clear()
```

Scilab code Exa 1.2 2

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 T=273+18.8;//temperature in K
5 p=713;//pressure mm of Hg
6 e=3;//vapour pressure mm of Hg
7 c=299792.5e3;//speed of light in km/s
8 f=11e6;//frequency in Hz
9 //calculation
10 n=1+(103.49/T*(p-e)+86.26/T*(1+5748.0/T)*e)/1e6;
11 V=c/n;
12 l=V/f;
13 disp(l,"wavelenght of light in m")
14 clear()
```

Scilab code Exa 1.3 3

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 T=273.0+30.0;//temperature in K
5 l=0.85;//wavelength in m
6 p=752.4;//pressure mm of Hg
7 c=299792.5e3;//speed of light in km/s
8 f=24e6;//frequency in Hz
9 //calculation
10 no=1+(287.604+4.8864/l**2+0.068/l**4)/1e6;
11 ns=1+(no-1)*273/T*p/760;
12 V=c/ns;
```

```
13 l=V/f;
14 disp(l,"wavelength of light in m")
15 clear()
```

Chapter 3

Trilateration

Scilab code Exa 3.1 4

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 AB=25145.32;//distance in m
5 R=6370.0e3;//radius of earth in m
6 ha=325.14;//elevation in m
7 //calculation
8 theta=AB*cos(3+9.0/60+40.0/3600)/R;
9 AB_dash=AB/sin(%pi/2+theta/2)*sin(%pi/2-theta
     /2-(3+9.0/60+40.0/3600)*%pi/180);
10 CD=AB_dash-AB_dash*ha/R;
11 S=CD+CD**3/24.0/R**2;
12 disp(S,"sea level length in m")
13 clear()
14 disp("answer varies slightly due to round off error"
     )
```

Scilab code Exa 3.2 5

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 AB=31325.14//slope distance in m
5 R=6370.0e3;//radius of earth
6 ha=1582.15;//elevation in m
7 h=4251.32-ha//in m
8 //calculation
9 AB_dash=AB-h**2/2/AB;
10 theta=2*asin(AB_dash/2/R);
11 AB_dash=AB-(h*sin(theta/2)+h**2/AB/2)
12 CD=AB_dash-AB_dash*ha/R;
13 S=CD+CD**3/24.0/R**2;
14 disp(S,"sea level length in m")
15 clear()
```

Scilab code Exa 3.3 6

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 //alpha=A and beta=B and those are angles
5 AB=1525.456;//distance in m
6 BC=2176.945;//distance in m
7 CD=1697.435;//distance in m
8 AD=2401.435;//distance in m
9 AC=3073.845;//distance in m
10 BD=2483.115;//distance in m
11 //calculation
12 A1=acos((CD**2+AC**2-AD**2)/(2*CD*AC));
13 A1=A1*180/%pi;
14 A2=acos((AD**2+BD**2-AB**2)/(2*AD*BD));
15 A2=A2*180/%pi;
16 A3=acos((AB**2+AC**2-BC**2)/(2*AB*AC));
17 A3=A3*180/%pi;
```

```
A4=acos((BC**2+BD**2-CD**2)/(2*BC*BD));
A4=A4*180/%pi;
B1=acos((CD**2+BD**2-BC**2)/(2*CD*BD));
B1=B1*180/%pi;
B2=acos((AD**2+AC**2-CD**2)/(2*AD*AC));
B2=B2*180/%pi;
B3=acos((AB**2+BD**2-AD**2)/(2*AB*BD));
B3=B3*180/%pi;
B4=acos((AC**2+BC**2-AB**2)/(2*AC*BC));
B4=B4*180/%pi;
e1=360-A1-A2-A3-A4-B1-B2-B3-B4;//error
e2=A1+B1-A3-B3;//error
e3=A2+B2-A4-B4;//error
//angle update
A1=A1+e1/8-e2/4;
A3=A3+e1/8+e2/4;
B1=B1+e1/8-e2/4;
B3=B3+e1/8+e2/4;
A2=A2+e1/8-e3/4;
B2=B2+e1/8-e3/4;
A4=A4+e1/8+e3/4;
B4=B4+e1/8+e3/4;
//updating sides
AD=1525.456*sin(B3*%pi/180)/sin(A2*%pi/180);
disp("equation for B2 is wrong")
disp(AD,"corrected length of AD in m")
BD=1525.456*sin(A3*%pi/180+B2*%pi/180)/sin(A2*%pi
   /180);
disp(BD,"corrected length of BD in m")
AC=1525.456*sin(A4*%pi/180+B3*%pi/180)/sin(B4*%pi
   /180);
disp(AC,"corrected length of AC in m")
BC=1525.456*sin(A3*%pi/180)/sin(B4*%pi/180);
disp(BC,"corrected length of BC in m")
CD=BC*sin(A4*%pi/180)/sin(B1*%pi/180)
disp(CD,"corrected length of CD in m")
disp("answers differ slightly due to value of pi");
//equation for B2 is wrong
```

```
54 clear()
```

Scilab code Exa 3.4 7

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 //angles found by cosine law
5 //alpha=A and beta=B and those are angles
6 A1=45.801596;//distance in m
7 A2=40.605250;//distance in m
8 A3=50.143258;//distance in m
9 A4=43.077646;//distance in m
10 B1=48.779868;//distance in m
11 B2=44.141587;//distance in m
12 B3=49.733152;//distance in m
13 B4=37.737035;//distance in m
14 //calculation
15 e1=360-A1-A2-A3-A4-B1-B2-B3-B4;//error
16 //angle update
17 A1=A1+e1/8;
18 A3=A3+e1/8;
19 B1=B1+e1/8;
20 B3=B3+e1/8;
21 A2=A2+e1/8;
22 B2=B2+e1/8;
23 A4=A4+e1/8;
24 B4=B4+e1/8;
25 E2=(log(sin(A1*%pi/180))*log(sin(A2*%pi/180))*log(
      sin(A3*%pi/180))*log(sin(A4*%pi/180))-log(sin(B1*
      %pi/180))*log(sin(B2*%pi/180))*log(sin(B3*%pi
      /180))*log(sin(B4*%pi/180)))/log(10000);
26 c3=E2/17.1;
27 c4=E2/17.0;
28 A1=A1-c3;
```

```
29 disp(A1,"corrected angle A1 in degrees")
30 B1=B1+c3;
31 disp(B1,"corrected angle B1 in degrees")
32 clear()
```

Chapter 4

Principles of Field Astronomy

Scilab code Exa 4.1 8

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 theta=25+14.0/60;//latitude in degrees in North
5 L1=29+15/60;//longitude in degrees in West
6 L2=45+25/60;//longitude in degrees in West
7 R=6370.0;//radius in km
8 //calculation
9 AB=cos(theta*%pi/180)*(L2-L1);//arc length in km
10 dis=2*%pi*R*AB/360.0;//distance in km
11 disp(dis,"distance of AB in m")
12 clear()
```

Scilab code Exa 4.2 9

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
```

```
4  function[dms]=degtodms(deg)
5      d = int(deg)
6      md = abs(deg - d) * 60
7      m = int(md)
8      sd = (md - m) * 60
9      sd=round(sd*100)/100
10     dms=[d m sd]
11 endfunction
12 LongA=52+24.0/60;//longtitude in degrees
13 LongB=55+30.0/60;//longtitude in degrees
14 latA=18+10.0/60;//latitude in degrees
15 latB=15.0;//latitude in degrees
16 R=6370.0;//radius of earth
17 pi=3.14;
18 //calculation
19 P=LongB-LongA;
20 PA=90-latA;
21 PB=90-latB;
22 AB=acos(cos(PB*%pi/180)*cos(PA*%pi/180)+sin(PB*%pi
      /180)*sin(PA*%pi/180)*cos(P*%pi/180));
23 dis=AB*R;
24 //solving for A
25 a=[0.5,0.5;0.5,-0.5];
26 b=[atan(cos((PB/2-PA/2)*%pi/180)/tan(P*%pi/180)/cos
      ((PB/2+PA/2)*%pi/180))*180/%pi;atan(sin((PB/2-PA
      /2)*%pi/180)/tan(P*%pi/180)/sin((PB/2+PA/2)*%pi
      /180))*180/%pi];
27 x=linsolve(a,-b);
28 x=degtodms(x(1));
29 disp(round(dis*100)/100,"distance of AB in Km");
30 disp(x,"direction of B to A in deg min sec towards
      east is:");
31 clear()
```

Scilab code Exa 4.3 10

```
1
2  clc; funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5      d = int(deg)
6      md = abs(deg - d) * 60
7      m = int(md)
8      sd = (md - m) * 60
9      sd=round(sd*100)/100
10     dms=[d m sd]
11 endfunction
12 b=40.0;//distance in degrees
13 p=6.0;//disatnce in degrees
14 //calculation
15 a=%pi/2-asin(cos(b*%pi/180)*cos(p*%pi/180));
16 Bc=a*180/%pi-b;
17 BC=Bc*1.853*60;
18 B=asin(sin(b*%pi/180)/sin(a))
19 B=degtodms(B*180/%pi);
20 disp(round(BC*100)/100,"distance BC in km");
21 disp(B,"angle of B deg min sec");
22 clear()
```

Scilab code Exa 4.4 11

```
1
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5      d = int(deg)
6      md = abs(deg - d) * 60
7      m = int(md)
8      sd = (md - m) * 60
9      sd=round(sd*100)/100
10     dms=[d m sd]
```

```
11 endfunction
12 coal=90.0-28.0-24.0/60;//coaltitude in degrees
13 cola=90.0-48.0-30.0/60;//colatitude in degrees
14 //calculation
15 delta=%pi/2-acos((cos(coal*%pi/180)*cos(cola*%pi
      /180)+sin(coal*%pi/180)*sin(cola*%pi/180)*cos(50*
      %pi/180)));
16 H=acos(cos(coal*%pi/180)/(sin(cola*%pi/180)*cos(
      delta))-tan(delta)/tan(cola*%pi/180));
17 Ho=degtodms(H*180/%pi);
18 delta=degtodms(delta*180/%pi)
19 disp(Ho,"H in deg min sec");
20 disp(delta,"declination in deg mi sec");
21 clear()
```

Scilab code Exa 4.5 12

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 delta=22+45.0/60;//declination in degrees
13 theta=55.0;//latitude in degrees
14 H=45+15.0/60;//hour angle in degrees
15 //calculation
16 alpha=asin((cos(H*%pi/180)+tan(theta*%pi/180)*tan(
      delta*%pi/180))*cos(theta*%pi/180)*cos(delta*%pi
      /180));
```

```
17 alpha=alpha*180/%pi;
18 A=acos(sin(delta*%pi/180)/(cos(theta*%pi/180)*cos(
      alpha*%pi/180))-tan(alpha*%pi/180)*tan(theta*%pi
      /180));
19 A=degtodms(360-A*180/%pi);
20 disp(A,"azimuth in deg mi sec");
21 clear()
```

Scilab code Exa 4.6 13

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 coal=42.0;//coalatitude in degrees
13 code=100+40.0/60//co-declination in degrees
14 //calculation
15 alpha=%pi/2-acos((cos(coal*%pi/180)*cos(code*%pi
      /180)+sin(coal*%pi/180)*sin(code*%pi/180)*cos(35*
      %pi/180)));
16 A=acos((cos(code*%pi/180)-cos(coal*%pi/180)*cos(%pi
      /2-alpha))/(sin(coal*%pi/180)*sin(%pi/2-alpha)));
17 A=degtodms(A*180/%pi);
18 alpha=degtodms(alpha*180/%pi);
19 disp(A,"azimuth in deg min sec towards east is:");
20 disp(alpha,"alpha in deg min sec");
21 clear()
```

Scilab code Exa 4.7 14

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 theta=33.0+42.0/60.0+34.0/3600.0;//latitude in
      degrees
13 delta=81.0+55.0/60.0+14.0/3600.0;//declination in
      degrees
14 //calculation
15 H1=acos(tan(theta*%pi/180)/tan(delta*%pi/180));
16 H1=degtodms(360-H1*180/%pi);
17 alpha=asin(sin(theta*%pi/180)/sin(delta*%pi/180));
18 alpha=degtodms(alpha*180/%pi);
19 A=asin(cos(delta*%pi/180)/cos(theta*%pi/180));
20 A=degtodms(A*180/%pi);
21 disp(A,"azimuth in deg min sec");
22 disp(alpha,"alpha in deg min sec");
23 disp(H1,"hour angle in deg min sec");
24 disp("the answer of azimuth differs slightly due to
      roundoff error and slight mistake in the book")
25 clear()
```

Scilab code Exa 4.8 15

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 alpha=0.0;//degrees
5 theta=25+45.0/60;//latitude in degrees
6 //calculation
7 delta=asin(sin(alpha)/sin(theta*%pi/180));
8 disp(delta,"declination in degrees")
9 clear()
```

Scilab code Exa 4.9 16

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 cola=90.0-49.0//colatitude in degrees
13 code=90.0+19.0//codeclination in degrees
14 //calculation
15 A1=acos((cos(code*%pi/180)-cos(cola*%pi/180)*cos(%pi
      /2))/sin(cola*%pi/180)/sin(%pi/2));
16 A1=degtodms(360-A1*180/%pi);
17 H=acos((0-cos(cola*%pi/180)*cos(code*%pi/180))/sin(
      cola*%pi/180)*sin(code*%pi/180));
18 H=degtodms(H*180/%pi);
19 disp(A1,"azimuth in deg min sec");
20 disp(H,"hour angle in deg min sec");
21 disp("the hour angle differs slightly due to round
```

```
    off error")
22 clear()
```

Scilab code Exa 4.10 17

```
1
2  clc();
3  funcprot(0);
4  // Initialization of Variable
5  function[dms]=degtodms(deg)
6      d = int(deg)
7      md = abs(deg - d) * 60
8      m = int(md)
9      sd = (md - m) * 60
10     sd=round(sd*100)/100;
11     if sd==60.0 then
12         sd=0;
13         m=m+1;
14     end
15     dms=[d m sd]
16 endfunction
17 //part1
18 delta=38+15.0/60;//declination of star M1 in degrees
       in North
19 theta=25+10.0/60;//latitude in degrees in North
20 //calculation
21 z=delta-theta;
22 alpha=90-z;
23 z=degtodms(z);
24 alpha=degtodms(alpha);
25 disp(z,"zenith distance in deg min sec");
26 disp(alpha,"altitude in deg min sec");
27 //part2
28 function[dms]=degtodms(deg)
29     d = int(deg)
```

```
30      md = abs(deg - d) * 60
31      m = int(md)
32      sd = (md - m) * 60
33      sd=round(sd*100)/100;
34      if sd==60.0 then
35          sd=0;
36          m=m+1;
37      end
38      dms=[d m sd]
39  endfunction
40  delta=22+40.0/60;//declination of star M2 in degrees
        in North
41  theta=25+10.0/60;//latitude in degrees in North
42  //calculation
43  z=-delta+theta;
44  alpha=90-z;
45  z=degtodms(z);
46  alpha=degtodms(alpha);
47  disp(z,"zenith distance in deg min sec");
48  disp(alpha,"altitude in deg min sec");
49  //part3
50  function[dms]=degtodms(deg)
51      d = int(deg)
52      md = abs(deg - d) * 60
53      m = int(md)
54      sd = (md - m) * 60
55      sd=round(sd*100)/100
56      if sd==60.0 then
57          sd=0;
58          m=m+1;
59      end
60      dms=[d m sd]
61  endfunction
62  delta=70+20.0/60;//declination of star M3 in degrees
        in North
63  theta=25+10.0/60;//latitude in degrees in North
64  //calculation
65  z=delta-theta;
```

```
66 z=degtodms(z);
67 disp(z,"zenith distance in deg min sec");
68 clear()
```

Scilab code Exa 4.11 18

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    if sd==60 then
11        m=m+1
12        sd=0
13        end
14    dms=[d m sd]
15 endfunction
16 theta=42+50.0/60;//latitudde in degrees
17 delta=83+40.0/60;//declination in degrees
18 //calculation
19 z=180-delta-theta;
20 alpha=90-z;
21 z=degtodms(z);
22 alpha=degtodms(alpha);
23 disp(z,"zenith distance in deg min sec");
24 disp(alpha,"altitude in deg min sec");
25 clear()
```

Scilab code Exa 4.12 19

```
1
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5      d = int(deg)
6      md = abs(deg - d) * 60
7      m = int(md)
8      sd = (md - m) * 60
9      sd=round(sd*100)/100
10     dms=[d m sd]
11 endfunction
12 //part1
13 M=82+30/60;//standard meridian in degrees
14 L1=110;//longitutde in degrees east
15 ST=18+35.0/60+10.0/3600//standard time in hr
16 //calculation
17 LMT=ST+(L1-M)/15.0;
18 LMT=degtodms(LMT);
19 disp(LMT,"LMT in hr min sec");
20 //part2
21 L2=30;//longitutde in degrees west
22 ST=18+35.0/60+10.0/3600//standard time in hr
23 //calculation
24 LMT=ST-(M+L2)/15.0;
25 LMT=degtodms(LMT);
26 disp(LMT,"LMT in hr min sec");
27 //part3
28 L3=30;//longitutde in degrees east
29 ST=18+35.0/60+10.0/3600//standard time in hr
30 //calculation
31 LMT=ST-(M-L3)/15.0;
32 LMT=degtodms(LMT);
33 disp(LMT,"LMT in hr min sec");
34 clear()
```

Scilab code Exa 4.13 20

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 //part1
13 LMT=8+30.0/60+15.0/3600;//in hr
14 Long=45+30.0/60;//longitude in degrees
15 //calculation
16 GMT=LMT+Long/15.0;
17 GMT=degtodms(GMT);
18 disp(GMT,"GMT in hr min sec (AM)");
19 //part2
20 LMT=6+40.0/60+10.0/3600;//in hr
21 Long=55+30.0/60;//longitude in degrees
22 //calculation
23 GMT=LMT-Long/15.0;
24 GMT=degtodms(GMT);
25 disp(GMT,"GMT in hr min sec (PM)");
26 clear()
```

Scilab code Exa 4.14 21

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
```

```
5       d = int(deg)
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
10      dms=[d m sd]
11  endfunction
12  //part1
13  GMT=20+30.0/60+15.0/3600;//GMT in hrs
14  Long=82+30.0/60;//longitude in degrees east
15  //calculation
16  LMT=GMT+Long/15.0-24;
17  LMT=degtodms(LMT);
18  disp(LMT,"LMT in hr min sec (next day)");
19  //part2
20  GMT=20+30.0/60+15.0/3600;//GMT in hrs
21  Long=120.0;//longitude in degrees west
22  //calculation
23  LMT=GMT-Long/15.0;
24  LMT=degtodms(LMT);
25  disp(LMT,"LMT in hr min sec (same day)");
26  clear()
```

Scilab code Exa 4.15 22

```
1
2   funcprot(0);
3   // Initialization of Variable
4   function[dms]=degtodms(deg)
5       d = int(deg)
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
10      dms=[d m sd]
```

```
endfunction
//part1
RA=6+15.0/60+20.0/3600;//RA in hr
HA=8+10.0/60+30.0/3600;//hour angle in hr
//calculation
LST=RA+HA;
LST=degtodms(LST);
disp(LST,"LST in hr min sec");
//part2
RA=8+40.0/60+15.0/3600;//RA in hr
HA=3+50.0/60+20.0/3600;//hour angle in hr
//calculation
LST=RA-HA;
LST=degtodms(LST);
disp(LST,"LST in hr min sec");
clear()
```

Scilab code Exa 4.16 23

```

funcprot(0);
// Initialization of Variable
function[dms]=degtodms(deg)
    d = int(deg)
    md = abs(deg - d) * 60
    m = int(md)
    sd = (md - m) * 60
    sd=round(sd*100)/100
    dms=[d m sd]
endfunction
//part1
LHA=6+30.0/60+10.0/3600;//local hour angle in hr
//calculation
LAT=LHA+12;
LAT=degtodms(LAT);
```

```
17 disp(LAT,"LAT in hr min sec");
18 //part2
19 LHA=18+40.0/60+20.0/3600;//local hour angle in hr
20 //calculation
21 LAT=LHA+12-24;
22 LAT=degtodms(LAT);
23 disp(LAT,"LAT in hr min sec");
24 clear()
```

Scilab code Exa 4.17 24

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 Long=60.0;//longitude in derees east
13 LHA=5+30.0/60+20.0/3600;//local hour angle in hr
14 //calculation
15 LMT=LHA+12;
16 GMT=LMT-Long/15;
17 GMT=degtodms(GMT);
18 LMT=degtodms(LMT);
19 disp(LMT,"LMT in hr min sec");
20 disp(GMT,"GMT in hr min sec");
21 clear()
```

Scilab code Exa 4.18 25

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 //parta
13 GMT=0;//GMT in hr
14 ET=10.0/60+1.8/3600;//ET in hrs
15 //calculaion
16 GAT=GMT+ET;
17 GAT=degtodms(GAT);
18 disp(GAT,"GAT in hr min sec");
19 //partb
20 GMT=0;//GMT in hr
21 ET=-13.0/60-28.5/3600;//ET in hrs
22 //calculaion
23 GAT=GMT+ET+24;
24 GAT=degtodms(GAT);
25 disp(GAT,"GAT in hr min sec");
26 clear()
```

Scilab code Exa 4.19 26

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
```

```
5       d = int(deg)
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
10      dms=[d m sd]
11  endfunction
12  ET1=-3.0/60-51.4/3600//ET at april 2 in hr
13  ET2=-3.0/60-33.5/3600//ET at april 3 in hr
14  //calculation
15  dET=(ET2-ET1)*18.0/24//change in ET
16  ET=ET1+dET;
17  ET=degtodms(ET);
18  disp(ET,"ET (-ve) in hr min s");
19  clear()
```

Scilab code Exa 4.20 27

```
1
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5       d = int(deg)
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
10      dms=[d m sd]
11  endfunction
12  LAT=15+12.0/60+40.0/3600;//latitude in degrees
13  Long=20+3.0/60;//longitude in degrees
14  GMN=5.0/60+10.65/3600;//GMN in hr
15  //calculation
16  GAT=LAT+Long/15.0;
17  e1=(GAT-12)*0.22/3600+GMN;
```

```
18 LAT=GAT+e1-Long/15.0;
19 LAT=degtodms(LAT);
20 disp(LAT,"LAT in hr min sec");
21 clear()
```

Scilab code Exa 4.21 28

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 Long=56+35.0/60;//Longitude in degrees
13 LMT=7+15.0/60+25.0/3600;//LMT in hr
14 GMN=3.0/60+54.0/3600;//GMT in hr
15 //calculation
16 GMT=LMT-Long/15.0;
17 e1=GMN+(12-GMN)*0.25/3600;
18 LAT=GMT+Long/15.0+e1;
19 LAT=degtodms(LAT);
20 disp(LAT,"LAT in hr min sec");
21 clear()
```

Scilab code Exa 4.22 29

```
1
2 funcprot(0);
```

```
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 ST=7+15.0/60+30.0/3600;//sideral time in hr
13 R=9.8296;//retardation in s
14 //calculation
15 tr=R/3600*ST;
16 ST=ST-tr;
17 ST=degtodms(ST);
18 disp(ST,"solar mean time in hr min sec");
19 clear()
```

Scilab code Exa 4.23 30

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 ST=7+45.0/60+50.0/3600;//solar time in hr
13 R=9.8565;//retardation in s
14 //calculation
15 tr=R/3600*ST;
```

```
16 ST=ST+tr;
17 ST=degtodms(ST);
18 disp(ST,"solar mean time in hr min sec");
19 clear()
```

Scilab code Exa 4.24 31

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 //part1
13 Long=140+35.0/60+20.0/3600;//longitude in degrees in
       West
14 GST=13+15.0/60+30.0/3600;//GST in hr
15 //calculation
16 LST=GST+9.8565/3600*Long/15.0;
17 LST=degtodms(LST);
18 disp(LST,"LST in hr min sec");
19 //part2
20 Long=160+45.0/60+30.0/3600;//longitude in degrees in
       East
21 GST=13+15.0/60+30.0/3600;//GST in hr
22 //calculation
23 LST=GST-9.8565/3600*Long/15.0;
24 LST=degtodms(LST);
25 disp(LST,"LST in hr min sec");
26 clear()
```

Scilab code Exa 4.25 32

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 Long=75.0;//longitude in degrees in West
13 GST=15+55.0/60+13.0/3600;//GST in hr
14 LMT=11.0;//LMT in hr
15 //calculation
16 LST=GST+Long/15.0*9.8565/3600+LMT+9.8565/3600*LMT;
17 LST=LST-24;
18 LST=degtodms(LST);
19 disp(LST,"LST of next day in deg min sec");
20 disp("there is slight change in the answer due to
     round off error in the question");
21 clear()
```

Scilab code Exa 4.26 33

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
```

```
5       d = int(deg)
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
10      dms=[d m sd]
11  endfunction
12  Long=75.0;//longitude in degrees
13  GST=5+25.0/60+15.0/3600;//GST in hr
14  LMT=5.0+40.0/60;//LMT in hr
15  //calculation
16  LST=GST-Long/15.0*9.8565/3600+LMT+9.8565/3600*(LMT);
17  LST=degtodms(LST);
18  disp(LST,"LST of next day in deg min sec");
19  clear()
```

Scilab code Exa 4.27 34

```
1
2   funcprot(0);
3   // Initialization of Variable
4   function[dms]=degtodms(deg)
5       d = int(deg)
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
10      dms=[d m sd]
11  endfunction
12  Long=75.0;//longitude in degrees
13  GST=11+45.0/60+10.0/3600;//GSt in hr
14  LST=26+35.0/60+42.0/3600;//LST in hr
15  //calculation
16  LMM=GST+Long/15*9.8565/3600;
17  LMT=LST-LMM-(LST-LMM)*9.8296/3600;
```

```
18 LMT=degtodms(LMT-12)
19 disp(LMT,"LMT in hr min sec (PM)");
20 clear()
```

Scilab code Exa 4.28 35

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 Long=90.0;//longitude in degrees
13 GST=9+15.0/60+14.0/3600;//GST in hr
14 LST=31+35.0/60+12.0/3600;//LST in hr
15 //calculation
16 LMM=GST-Long/15*9.8565/3600;
17 LMT=LST-LMM-(LST-LMM)*9.8296/3600;
18 LMT=degtodms(LMT-12)
19 disp(LMT,"LMT in hr min sec (PM)");
20 clear()
```

Scilab code Exa 4.29 36

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
```

```
5       d = int(deg)
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
10      dms=[d m sd]
11  endfunction
12  //part1
13  Long=150.0;//longitude in degrees
14  GST=12+25.0/60+15.0/3600;//GST in hr
15  LST=30+15.0/60+10.0/3600;//LST in hr
16  LMN=18+15.0/60+10.0/3600;//LMN in hr
17  //calculation
18  LMM=GST+Long/15*9.8565/3600;
19  LMT=LMN-LMM-(LMN-LMM)*9.8296/3600;
20  LMT=degtodms(LMT)
21  disp(LMT,"LMT in hr min sec (PM)");
22  //part2
23  LMM=GST+Long/15*9.8565/3600;
24  LMT=LST-LMM-(LST-LMM)*9.8296/3600;
25  LMT=degtodms(LMT-12)
26  disp(LMT,"LMT in hr min sec (AM)");
27  clear()
```

Scilab code Exa 4.30 37

```
1
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5       d = int(deg)
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
```

```
10      dms=[d m sd]
11  endfunction
12  theta=35+15.0/60+20.0/3600;//theta in degrees
13  delta=88+15.0/60+45.0/3600;//delta in degrees
14  RA=1+45.0/60+15.0/3600;//R.A. in degrees
15  //calculation
16  H=acos(tan(theta*%pi/180)/tan(delta*%pi/180));
17  H=H*180/%pi/15;
18  LST=RA+H;
19  LST=degtodms(LST);
20  disp(LST,"LST in hr min sec");
21  clear()
```

Scilab code Exa 4.31 38

```
1
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5      d = int(deg)
6      md = abs(deg - d) * 60
7      m = int(md)
8      sd = (md - m) * 60
9      sd=round(sd*100)/100
10     dms=[d m sd]
11 endfunction
12 RA=22+25.0/60+10.0/3600;//R.A. in hr
13 ST=14+45.0/60//sidereal time in hr
14 Long=90.0;//longitude in degrees
15 GMT=27+15.0/60;//GMT in hr
16 LMN=15+21.0/60+15.0/3600;//LST of LMN in hr
17 //calculation
18 MT=12+24-GMT+Long/15//mean time interval
19 acc=9.8565/3600*MT;
20 HA=LMN-acc-MT;
```

```
21 LST=HA+24-RA;
22 LST=degtodms(LST);
23 disp(LST,"LST in hr min sec");
24 clear()
```

Scilab code Exa 4.32 39

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 //part1
13 Long=60;//longitude in degrees
14 GMT=11+15.0/60+20.0/3600;//GMT in hr
15 //calculation
16 LMT=GMT-Long/15*9.8296/3600;
17 LMT=degtodms(LMT);
18 disp(LMT,"LMT in hr min sec ");
19 //part2
20 Long=45;//Longitude in degrees
21 GMT=11+15.0/60+20.0/3600;//GMT in hr
22 //calculation
23 LMT=GMT+Long/15*9.8296/3600;
24 LMT=degtodms(LMT);
25 disp(LMT,"LMT in hr min sec");
26 clear()
```

Scilab code Exa 4.33 40

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 Long=75;//Longitude in degrees
13 GMT=6+18.0/60+20.0/3600;//GMT in hr
14 LST=10+25.0/60+15.0/3600;//LST in hr
15 //calculation
16 LMT=GMT+Long/15*9.8296/3600;
17 LST=LST-9.8296/3600*LST;
18 LMT=LMT+LST;
19 LMT=degtodms(LMT);
20 disp(LMT,"LMT in hr min sec ");
21 clear()
```

Scilab code Exa 4.34 41

```
1
2 funcprot(0);
3 // Initialization of Variable
4 //Part A
5 function[dms]=degtodms(deg)
6     d = int(deg)
```

```
7       md = abs(deg - d) * 60
8       m = int(md)
9       sd = (md - m) * 60
10      sd=round(sd*100)/100
11      dms=[d m sd]
12  endfunction
13  GST=7+35.0/60+40.0/3600;//GSt in hr
14  //calculation
15  GMT=24-GST-(24-GST)*9.8296/3600;
16  GMT=degtodms(GMT);
17  disp(GMT,"GMT in hr min sec");
18  //Part B
19  function[dms]=degtodms(deg)
20      d = int(deg)
21      md = abs(deg - d) * 60
22      m = int(md)
23      sd = (md - m) * 60
24      sd=round(sd*100)/100
25      dms=[d m sd]
26  endfunction
27  //part1
28  Long=120.0;//longitude in degrees
29  GMT=12+3.0/60+24.6/3600;//GMT in hr
30  //calculation
31  LMT=GMT-17.8/24*Long/15.0/3600;
32  LMT=degtodms(LMT);
33  disp(LMT,"LMT of LAN in hr min sec");
34  //part2
35  Long=45;//Longitude in degrees
36  GMT=12+3.0/60+24.6/3600;//GMT in hr
37  //calculation
38  LMT=GMT+17.8/24*Long/15.0/3600;
39  LMT=degtodms(LMT);
40  disp(LMT,"LMT of LAN in hr min sec");
41  clear()
```

Scilab code Exa 4.35 42

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 //one of the 2 solution
13 f0=5+1.9/60;//declination in degrees
14 n=0.25;//constant
15 del0=0;//del''0
16 del1=-0.1;//del''1
17 d2=23.0//del1/2
18 //calculation
19 fn=f0+n*d2/60+n*(n-1)/2*(del1+del0)/60;
20 fn=degtodms(fn)
21 disp(fn,"sun declination in deg min sec");
22 clear()
```

Scilab code Exa 4.36 43

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
```

```
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
10      dms=[d m sd]
11  endfunction
12  alt=23+40.0/60;//altitude of star in degrees
13  azi=145.0;//azimuth of star in degrees
14  lat=50.0;//latitude in degrees
15  //calculation
16  delta=%pi/2-acos(cos(%pi/2-lat*%pi/180)*cos(%pi/2-
       alt*%pi/180)+sin(%pi/2-lat*%pi/180)*sin(%pi/2-alt
       *%pi/180)*cos(azi*%pi/180));
17  H=acos((cos(%pi/2-alt*%pi/180)-cos(%pi/2-lat*%pi
       /180)*cos(%pi/2-delta))/sin(%pi/2-lat*%pi/180)*
       sin(%pi/2-delta))
18  H=degtodms(360-H*180/%pi);
19  delta=degtodms(delta*180/%pi);
20  disp("there is a calculation mistake in calculating
       H in the book");
21  disp(delta,"declination in deg min sec");
22  disp(H,"hour angle in deg min sec");
23  clear()
```

Scilab code Exa 4.37 44

```
1
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5       d = int(deg)
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
```

```
10      dms=[d m sd]
11  endfunction
12  alt=25+30.0/60;//altitude in degrees
13  azi=45.0;//azimuth in degrees
14  lat=42.0;//latitude in degrees
15  //calculation
16  delta=%pi/2-acos(cos(%pi/2-lat*%pi/180)*cos(%pi/2-
       alt*%pi/180)+sin(%pi/2-lat*%pi/180)*sin(%pi/2-alt
       *%pi/180)*cos(azi*%pi/180));
17  H=acos((cos(%pi/2-alt*%pi/180)-cos(%pi/2-lat*%pi
       /180)*cos(%pi/2-delta))/sin(%pi/2-lat*%pi/180)*
       sin(%pi/2-delta))
18  H=degtodms(H*180/%pi);
19  delta=degtodms(delta*180/%pi);
20  disp(delta,"declination in deg min sec");
21  disp(H,"hour angle in deg min sec");
22  clear()
```

Scilab code Exa 4.38 45

```
1
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5      d = int(deg)
6      md = abs(deg - d) * 60
7      m = int(md)
8      sd = (md - m) * 60
9      sd=round(sd*100)/100
10     dms=[d m sd]
11 endfunction
12 delta=21.0*%pi/180+25.0/60*%pi/180;//delta in
       degrees
13 lat=25+40.0/60;//latitude in degrees
14 //calculation
```

```
15 H=acos((0-cos(%pi/2-lat*%pi/180)*cos(%pi/2-delta))/
      sin(%pi/2-lat*%pi/180)*sin(%pi/2-delta));
16 A=acos(cos(%pi/2-delta)/sin(%pi/2-lat*%pi/180));
17 H=degtodms(360-H*180/%pi);
18 A=degtodms(A*180/%pi);
19 disp(H,"hour angle in deg min sec");
20 disp(A,"azimuth in deg min sec");
21 disp("the answer differs slightly due to round off
      error");
22 clear()
```

Scilab code Exa 4.39 46

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 //calculation
13 A=[1,1;1,-1];//matrix
14 b=[90;0];//matrix
15 x=linsolve(A,-b);
16 disp(x(1),"latitude in degrees")
17 clear()
```

Scilab code Exa 4.40 47

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 theta=53+20.0/60;//theta in degrees
13 delta=53+20.0/60;//delta in degrees
14 //calculation
15 alpha=theta+delta-90;
16 alpha=degtodms(alpha);
17 disp(alpha,"altitude in deg min sec");
18 clear()
```

Scilab code Exa 4.41 48

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 GMT=18+30.0/60;//GMT in hr
13 ET=1.0/60+25.4/3600-0.67*6.5/3600;//ET in hr
14 //calculation
```

```
15 GAT=GMT+ET;
16 GAT=degtodms(GAT)
17 disp(GAT,"GAT in hr min sec");
18 clear()
```

Scilab code Exa 4.42 49

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 Long=30.0;//longitude in degrees
13 GAT=13+15.0/60+10.0/3600;//GAT in hr
14 ET=6.0/60+15.35/3600+0.3/3600*1.25278;//ET in hr
15 //calculation
16 LMT=GAT+ET-Long/15.0;
17 LMT=degtodms(LMT);
18 disp(LMT,"LMT in hr min sec");
19 clear()
```

Scilab code Exa 4.43 50

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
```

```
5       d = int(deg)
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
10      dms=[d m sd]
11  endfunction
12  Long=45.0;//longitude in degrees
13  E=11+55.0/60+5.0/3600-1.5/6*17.0/3/3600;//E in hr
14  //calculation
15  GMT=14+40.0/60+Long/15.0;
16  GHA=GMT+E;
17  LHA=GHA-24-Long/15;
18  LHA=degtodms(LHA);
19  disp(LHA,"LHA of the sun in hr min sec");
20  clear()
```

Scilab code Exa 4.44 51

```
1
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5       d = int(deg)
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
10      dms=[d m sd]
11  endfunction
12  E
       =11+55.0/60+24.0/3600+0.5/3600*(2+40.0/60+21.2/3600)
       ;//E in hr
13  GHA=8+35.0/60+45.2/3600;//GHA in hr
14  //calculation
```

```
15 GMT=GHA+24-E;
16 GMT=degtodms(GMT);
17 disp(GMT,"GMT in hr min sec");
18 clear()
```

Chapter 5

Uses Of Field Astronomy in surveying

Scilab code Exa 5.1 52

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 l1=11.5;//position
13 l2=13.5;//position
14 r1=8.5;//position
15 r2=6.5;//position
16 alpha=3+15.0/60+28.0/3600;//angle in hr
17 OB=121+45.0/60+18.0/3600;//angle in hr
18 OA=43+25.0/60+20.51/3600;//angle in hr
19 //calculation
```

```
20 gamma=(l1+l2)/4-(r1+r2)/4;
21 e=gamma*tan(alpha*%pi/180)/3600//correction
22 CH=OB-OA-e;
23 CH=degtodms(CH);
24 disp(CH, "corrected horizontal angle in deg,min,sec
      respectively");
25 clear()
26 disp("answer varies slightly due to round off error"
      )
```

Scilab code Exa 5.2 53

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 alpha=30+32.0/60+18.0/3600//latitude in hr
13 d=16.0/60+2.85/3600//semi-diameter of sun in hr
14 //calculation
15 C1=-58.0/3600/tan(alpha*%pi/180);
16 C2=8.8/3600*cos(alpha*%pi/180);
17 C3=d;
18 CL=alpha+C1+C2+C3;
19 CL=degtodms(CL);
20 disp(CL,"corrected latutude in deg,min,sec
      respectively");
21 clear()
```

Scilab code Exa 5.3 54

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 alpha=40+52.0/60+10.0/3600//latitude in hr
13 //calculation
14 C1=-58.0/3600/tan(alpha*%pi/180);
15 CL=alpha+C1;
16 CL=degtodms(CL);
17 disp(CL,"corrected latutude in deg,min,sec
      respectively");
18 clear()
```

Scilab code Exa 5.4 55

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
```

```
9       sd=round(sd*100)/100
10      dms=[d m sd]
11  endfunction
12  LMT=21+23.0/60+05.0/3600//local chronometer time
13  Long=65.0+19.0/60//longitude in hr
14  GST=13+15.0/60+20.0/3600;//GST in hr
15  RA=9+32.0/60+15.0/3600;//RA in hr
16  Long2=82.0+30.0/60//longitude of India
17  //calculation
18  e1=Long/15*9.8565/3600//error
19  SIT=RA+24-GST+e1//sidereal time interval after LMM
20  e2=SIT*9.8296/3600//error
21  MI=SIT-e2//mean interval after LMM
22  LMT=LMT-(Long2-Long)/15.0;
23  CE=MI-LMT;
24  CE=degtodms(CE);
25  disp(CE,"chronometer error in hours,min,sec
        respectively (fast)");
26  clear()
```

Scilab code Exa 5.5 56

```
1
2   funcprot(0);
3   // Initialization of Variable
4   function[dms]=degtodms(deg)
5       d = int(deg)
6       md = abs(deg - d) * 60
7       m = int(md)
8       sd = (md - m) * 60
9       sd=round(sd*100)/100
10      dms=[d m sd]
11  endfunction
12  MST=12+32.0/60+15.0/3600//mean sidereal time in hr
13  RA=15+45.0/60+10.0/3600;//RA in hr
```

```
14 theta=55+14.0/60+20.0/3600//latitude
15 delta=15+24.0/60+30.0/3600//declination
16 alpha=35+44.0/60+10.0/3600//zenith distance
17 //calculation
18 c=90-theta;
19 p=90-delta;
20 z=90-alpha;
21 H=acos(cos(z*%pi/180)/sin(c*%pi/180)/sin(p*%pi/180)
      -1/(tan(p*%pi/180)*tan(c*%pi/180)))
22 H=H/15*180/%pi;
23 LST=RA-H;
24 CE=MST-LST;
25 CE=degtodms(CE);
26 disp(CE,"chronometer error in hours,min,sec
      respectively (fast)");
27 clear()
```

Scilab code Exa 5.6 57

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=round(sd*100)/100
10    dms=[d m sd]
11 endfunction
12 LMTe=6+34.0/60+18.0/3600//  LMT east
13 LMTw=8+58.0/60+2.0/3600// LMT west
14 RA=16+11.0/60+25.0/3600;//RA in hr
15 Long=125+33.0/60;//Longitude
16 GST=8+25.0/60+14.0/3600;//GST in hr
```

```
17 //calculation
18 e1=Long/15*9.8565/3600//error
19 SIT=RA-GST+e1//sidereal time interval after LMM
20 e2=SIT*9.8296/3600;
21 MI=SIT-e2//mean time interval after LMM
22 LMTav=(LMTe+LMTw)/2//mean LMT
23 CE=LMTav-MI;
24 CE=degtodms(CE);
25 disp(CE,"chronometer error in slower side in hours,
      min,sec respectively (slow)");
26 clear()
```

Scilab code Exa 5.7 58

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=(round(sd*100)/100)
10      dms=[d m sd]
11 endfunction
12 LMM=15+9.0/60+5.21/3600// mean LMT
13 GMT=10+9.0/60+3.76/3600;//GMT in hr
14 Long=75.0//longitude
15 alpha=42+30.0/60+42.0/3600;//angle in degrees
16 theta=34+48.0/60+12.0/3600;//angle in degrees
17 delta=15+36.0/60+48.0/3600;//angle in degrees
18 //calculation
19 H=acos(sin(alpha*%pi/180)/cos(theta*%pi/180)/cos(
      delta*%pi/180)-(tan(delta*%pi/180)*tan(theta*%pi
      /180)))
```

```
20 H=H/15*180/%pi;
21 GAT=12+H-Long/15;
22 LMT=GAT+Long/15-5.0/60-40.0/3600;
23 CE=LMM-LMT;
24 CE=degtodms(CE);
25 disp(CE,"chronometer error in slower side in hours,
      min,sec respectively (fast)");
26 clear()
```

Scilab code Exa 5.8 59

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=(round(sd*100)/100)
10      dms=[d m sd]
11 endfunction
12 del1=75+14.0/60+20.0/3600;//declination in degrees
13 del2=70+12.0/60+30.0/3600;//declination in degrees
14 d=del1-del2;//difference in degrees
15 //calculation
16 k=cos(del1*%pi/180)/cos(del2*%pi/180);
17 A2=%pi/2-atan((cos(d*%pi/180)-k)/sin(d*%pi/180));
18 A2=A2*180/%pi;
19 A2=120+15.0/60+10.0/3600-A2;
20 CR=360-A2;
21 A2=degtodms(A2);
22 CR=degtodms(CR);
23 disp(A2,"azimuth of angle R in degree,minites,
      seconds respectively");
```

```
24 disp(CR,"true bearing of CR in degree,minites,
     seconds respectively");
25 clear()
```

Scilab code Exa 5.9 60

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=(round(sd*100)/100)
10      dms=[d m sd]
11 endfunction
12 a=26.0/60+51.0/3600;//angle in degrees
13 p=56.0/60+5.1/3600//polar distance
14 //calculation
15 H=acos(a/p);
16 A=p*sin(H)/cos(30.75694*%pi/180);
17 CR=25+35.0/60+40.0/3600-A;
18 CR=degtodms(CR);
19 disp(CR,"azimuth of angle CR in degree,minites,
     seconds respectively");
20 disp("answer varies slightly due to round off error"
     )
21 clear()
```

Scilab code Exa 5.10 61

```
1
```

```
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5      d = int(deg)
6      md = abs(deg - d) * 60
7      m = int(md)
8      sd = (md - m) * 60
9      sd=(round(sd*100)/100)
10       dms=[d m sd]
11 endfunction
12 Long=75.0//longitude in degrees
13 GST=11+40.0/60+32.4/3600;//GST in degrees
14 RA=12+25.0/60+18.35/3600;//RA in degrees
15 GMT=15+45.0/60+25.3/3600;//GMT in degrees
16 delta=22+6.0/60+32.5/3600;//angle in degrees
17 //calculation
18 e1=Long/15*9.8565/3600;
19 LSTofLMM=GST-e1;
20 LMT=GMT+Long/15;
21 SIT=LMT+LMT*9.8565/3600//sidereal time interval
22 LHA=SIT+LSTofLMM;
23 H=RA+24-LHA;
24 H=H*15;
25 B=atan(tan(delta*%pi/180)*tan(H*%pi/180));
26 B=B*180/%pi;
27 A=atan(tan(H*%pi/180)*cos(B*%pi/180)/sin((B
      -32-15.0/60)*%pi/180))
28 A=A*180/%pi;
29 TB=360+A-135-15.0/60-20.0/3600;
30 TB=degtodms(TB);
31 disp(TB,"true bearing TB in degree,minites,seconds
      respectively");
32 disp("there is slight difference in the answers due
      to rounding off error in the book");
33 clear()
```

Scilab code Exa 5.11 62

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=(round(sd*100)/100)
10      dms=[d m sd]
11 endfunction
12 z=51+47.0/60+18.0/3600//zenith distance
13 p=88+57.0/60+57.0/3600//polar distance
14 c=61+27.0/60+55.0/3600//co-latitude
15 //calculation
16 s=(z+p+c)/2;
17 A=2*atan(sqrt(sin((s-z)*%pi/180)/sin(s*%pi/180)*sin
   ((s-c)*%pi/180)/sin((s-p)*%pi/180)));
18 A=A*180/%pi;
19 TB=360-A-165-18.0/60-20.0/3600;
20 TB=degtodms(TB);
21 disp(TB,"true bearing TB in degree,minites,seconds
   respectively");
22 disp("answer varies slightly due to round off error"
   )
23 clear()
```

Scilab code Exa 5.12 63

```
1
```

```
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5      d = int(deg)
6      md = abs(deg - d) * 60
7      m = int(md)
8      sd = (md - m) * 60
9      sd=(round(sd*100)/100)
10       dms=[d m sd]
11 endfunction
12 z2=90-40-13.0/60-15.0/3600;//zenith angle in degrees
13 del2=12+15.0/60+30.0/3600//declination of star in
      degrees
14 //calculation
15 theta=z2+del2;
16 theta=degtodms(theta);
17 disp(theta,"altitude in degree,minites,seconds
      respectively");
18 clear()
```

Scilab code Exa 5.13 64

```
1
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5      d = int(deg)
6      md = abs(deg - d) * 60
7      m = int(md)
8      sd = (md - m) * 60
9      sd=round(sd*100)/100;
10     if sd==60.0 then
11         sd=0;
12         m=m+1;
13     end
```

```
14      dms=[d m sd]
15  endfunction
16  alpha1=30+45.0/60+25.0/3600;//angle in degrees
17  alpha2=40+48.0/60+30.0/3600;//angle in degrees
18  //calculation
19  e1=-58/3600/tan(alpha1*%pi/180)// error 1
20  e2=-58/3600/tan(alpha2*%pi/180)// error 2
21  theta=(alpha1+alpha2+e1+e2)/2;
22  theta=degtodms(theta)
23  disp(theta,"latitude in degree,minites,seconds
       respectively");
24  clear()
```

Scilab code Exa 5.14 65

```
1
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5      d = int(deg)
6      md = abs(deg - d) * 60
7      m = int(md)
8      sd = (md - m) * 60
9      sd=(round(sd*100)/100)
10       dms=[d m sd]
11 endfunction
12 ZP=37+29.0/60+40.0/3600//colatitde in degrees
13 ZM=56+24.0/60+50.0/3600//coaltitude in degrees
14 PM=67+54.0/60+24.0/3600//codeclination in degrees
15 //calculation
16 A1=acos((cos(PM*%pi/180)-cos(ZP*%pi/180)*cos(ZM*%pi
       /180))/(sin(ZP*%pi/180)*sin(ZM*%pi/180)));
17 A1=A1*180/%pi;
18 A=360-A1;
19 A=degtodms(A);
```

```
20 disp(A,"azimuth of sun in degree,minites,seconds
     respectively");
21 clear()
```

Scilab code Exa 5.15 66

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=(round(sd*100)/100)
10      dms=[d m sd]
11 endfunction
12 theta=54+30.0/60//latitude in degrees
13 delta=62+12.0/60+21.0/3600//declination in degrees
14 //calculation
15 alpha=asin(sin(theta*%pi/180)/sin(delta*%pi/180));
16 A1=acos(tan(theta*%pi/180)/tan(alpha));
17 A1=A1*180/%pi;
18 TB=360-A1-65-18.0/60-42.0/3600;
19 TB=degtodms(TB);
20 alpha=degtodms(alpha*180/%pi);
21 H=acos(tan(theta*%pi/180)/tan(delta*%pi/180));
22 H=degtodms(H*180/%pi);
23 disp(TB,"true bearing in degree,minites,seconds
     respectively");
24 disp(alpha,"altitude in degree,minites,seconds
     respectively");
25 disp(H,"hour angle in degree,minites,seconds
     respectively");
26 disp("the answer for hour angle in the textbook is
```

```
    wrong");
27  clear()
```

Scilab code Exa 5.16 67

```
1
2  funcprot(0);
3  // Initialization of Variable
4  function[dms]=degtodms(deg)
5      d = int(deg)
6      md = abs(deg - d) * 60
7      m = int(md)
8      sd = (md - m) * 60
9      sd=round(sd*100)/100;
10     if sd==60.0 then
11         sd=0;
12         m=m+1;
13     end
14     dms=[d m sd]
15 endfunction
16 alpha=44+12.0/60+30.0/3600;//angle in degrees
17 d=15.0/60+45.86/3600//diameter correction
18 Long=7+20.0/60+15.0/3600//longitude in degrees
19 //calculation
20 alpha=alpha+d-58/3600/tan(alpha)+8.8/3600*cos(alpha)
       ;
21 GAT=Long/15;
22 e2=6.82/3600*GAT;
23 delta=22+18.0/60+12.8/3600+e2;
24 theta=delta+90-alpha;
25 theta=degtodms(theta);
26 disp(theta,"altitude in degree,minites,seconds
       respectively");
27 disp("answer varies slightly due to round off error"
       );
```

```
28 clear()
```

Scilab code Exa 5.17 68

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=(round(sd*100)/100)
10      dms=[d m sd]
11 endfunction
12 GMT=16+22.0/60+55.0/3600;
13 ET=3.0/60+43.0/3600;
14 c=90-42-20.0/60;
15 p=90-18-45.0/60-50.0/60;
16 z=90-43-38.0/60;
17 //calculation
18 H=acos(cos(z*%pi/180)/sin(c*%pi/180)/sin(p*%pi/180)
   -1/tan(c*%pi/180)*1/tan(p*%pi/180));
19 H=H*180/%pi;
20 LAT=12-H/15;
21 LMT=LAT-ET;
22 Long=GMT-LMT;
23 Long=Long*15;
24 Long=degtodms(Long);
25 disp(Long,"Longitude in degree,minites,seconds
   respectively in west");
26 disp("the answer varies slightly due to round off
   error");
27 clear()
```

Scilab code Exa 5.18 69

```
1
2 funcprot(0);
3 // Initialization of Variable
4 function[dms]=degtodms(deg)
5     d = int(deg)
6     md = abs(deg - d) * 60
7     m = int(md)
8     sd = (md - m) * 60
9     sd=(round(sd*100)/100)
10       dms=[d m sd]
11 endfunction
12 alpha=21+35.0/60+30.0/3600//mean observed altitude
13 C=(4.5+5.5-3.5-2.5)/4*15.0/3600;
14 c=44+30.0/60//colatitude in degrees
15 z=68+26.0/60+34.0/3600//coaltitude in degrees
16 p=94+4.0/60+15.0/3600//codeclination in degrees
17 s=(c+p+z)/2;
18 //calculation
19 cr=-58/3600/tan(alpha)//correction refraction
20 cp=8.8/3600*cos(alpha)//correction parallax
21 alpha=alpha+C+cr+cp// corrected altitude
22 A=2*atan(sqrt(sin((s-z)*%pi/180)/sin(s*%pi/180)*sin
     ((s-c)*%pi/180)/sin((s-p)*%pi/180)));
23 A=A*180/%pi;
24 Mh=(121+45.0/60+20.0/3600+122+47.0/60)/2//mean
     horizontal angle
25 AZ=360-Mh-A;
26 AZ=degtodms(AZ);
27 disp(AZ,"Azimuth from north(clockwise) in degree,
     minites,seconds respectively");
28 disp("the answer varies slightly due to round off
     error")
```

```
29 clear()
```

Chapter 6

Photogrammetry

Scilab code Exa 6.1 70

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 Da=184.32;//distance in mm
5 Db=95.84;//distance in mm
6 Ax=-115.0;//x coordinate of A
7 By=-115.0;//y coordinate of B
8 //calculation
9 phi=atan(Ax/By);
10 AB=sqrt(Ax**2+By**2);
11 theta=acos((Da**2+AB**2-Db**2)/2/Da/AB);
12 alpha=phi-theta;
13 xc=Da*cos(alpha)-115.0;
14 disp(xc,"the coordiantes in mm x is");
15 yc=-Da*sin(alpha);
16 disp(yc,"the coordiantes in mm y is");
17 clear()
```

Scilab code Exa 6.2 71

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 f=0.152;//focal length in m
5 H=1800;//elevation of topmost point in m
6 h=300;//elevation of ground in m
7 //calculation
8 S=f/(H-h);
9 disp(round(1/S),"scale of photograph in 1 in")
10 clear()
```

Scilab code Exa 6.3 72

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 f=0.150 //focal length in m
5 h1=1500.0;//elevation A in m
6 h2=1200.0;//elevation B in m
7 h3=1000.0;//elevation C in m
8 H=3000.0;//height in m
9 //calculstion
10 hav=1.0/3*(h1+h2+h3);
11 S1=f/(H-h1);
12 disp(1/S1,"scale of point 1 in 1 in");
13 S2=f/(H-h2);
14 disp(1/S2,"scale of point 2 in 1 in");
15 S3=f/(H-h3);
16 disp(round(1/S3),"scale of point 3 in 1 in");
17 Sav=f/(H-hav);
18 disp(round(1/Sav),"average scale  in 1 in");
19 clear()
```

Scilab code Exa 6.4 73

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 ab=188.0;//distance in m
5 AB=120;//distance in m
6 Sm=1.0/20000;
7 //calculation
8 S=ab/AB*Sm;
9 disp(1/S,"scale of photograph in 1 in");
10 clear()
```

Scilab code Exa 6.5 74

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 xa=45.35;
5 xb=-40.16;
6 f=152.4;//focal length
7 H=1500.0;//actual height
8 ha=200.0;//height A
9 hb=150.0;//height B
10 ya=38.41;
11 yb=-45.65;
12 //calculation
13 Xa=xa*(H-ha)/f;
14 Ya=ya*(H-hb)/f;
15 Xb=xb*(H-ha)/f;
16 Yb=yb*(H-hb)/f;
17 AB=sqrt((Xb-Xa)**2+(Yb-Ya)**2);
18 disp(AB,"distance of AB in m");
19 clear()
```

Scilab code Exa 6.6 75

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 d=62.4;//displacement in mm
5 H=250.0;//height of datum m
6 r=115.4;//image distance in mm
7 //calculation
8 h=H*d/r;
9 disp(h,"height of chimney in m")
10 clear()
```

Scilab code Exa 6.7 76

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 ra=88.25;//image distance of A in mm
5 rb=81.23;//image distance of B in mm
6 rc=68.14;//image distance of C in mm
7 H=2000.0;// in m
8 ha=255;//distance in m
9 hb=200;//distance in m
10 hc=145;//distance in m
11 f=0.1524;//focal length in m
12 //calculation
13 aa=ra*ha/H;
14 disp(aa,"relief distance of A in mm");
15 bb=rb*hb/H;
16 disp(bb,"relief distance of B in mm");
17 cc=rc*hc/H;
```

```
18 disp(cc,"relief distance of C in mm");
19 S=f/H;
20 disp(1/S,"scale of photograph in 1 in");
21 clear()
```

Scilab code Exa 6.8 77

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 f=0.1524;//focal length in m
5 S=0.08251/1000;//scale
6 //calculation
7 H=f/S;
8 disp(H,"flying height in m");
9 clear()
```

Scilab code Exa 6.9 78

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 AB=610;// ground length in m
5 Xa=18.35;//in mm
6 Xb=106.41;//in mm
7 Ya=-62.41;//in mm
8 Yb=-21.43;//in mm
9 Ha=435;//elevation in m
10 Hb=452;//elevation in m
11 f=0.1524*1000;//focal length in m
12 //calculation
13 //solving the quadratic polynomial in H
14 //a=(Xb(H-Hb)-Xa(H-Ha))/f
```

```
15 //b=(Yb(H-Hb)-Ya(H-Ha))/f
16 //AB=sqrt(a^2+b^2)
17 //0=0.4064-365.929H-289685.07
18 //H=poly([-289685.926  -365.929  0.4064],'x','coeff')
19 //h=roots(H)
20 //disp(h(1),"height required in m")
21 function [f]=equation(x)
22     f=610^2-((Xb/f*(x-Hb)-Xa/f*(x-Ha))^2+(Yb/f*(x-Hb
       )-Ya/f*(x-Ha))^2)
23 endfunction
24 //initial guess
25 x=1407;
26 //deff('y=f(x)','y=f');
27 y=fsolve(x,equation);
28 disp(round(y),"height required in m")
29 clear()
```

Scilab code Exa 6.10 79

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 S=1.0/10000;//scale
5 A=500.0;//area in sq. km
6 pw=0.3;//side overlap
7 l=0.23;//length in mm
8 w=0.23;//width in mm
9 //calculation
10 a=(1-0.6)*(1-pw)*l*w/S**2/1000/1000;
11 N=A/a;
12 disp(round(N),"no. of photographs taken")
13 clear()
```

Scilab code Exa 6.11 80

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 L=25.0e3;//length in m
5 k=0.23e4;//l/s=w/s;
6 pl=0.6;//longitudinal lap
7 pw=0.3;//side lap
8 W=20.0e3;//width in m
9 //calculation
10 N=((L/((1-pl)*k)+1))*((W/((1-pw)*k)+1)+1);
11 disp(N,"no. of photographs taken");
12 clear()
```

Scilab code Exa 6.12 81

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 //Part A page 310
5 f=0.1524;//focal length
6 S=1.0/10000;//scale
7 pw=0.3;//side lap
8 w=0.23;//format width
9 pl=0.6;
10 l=0.23;
11 //calculation
12 W=(1-pw)/S*w;
13 H=f/S+300;
14 disp(H,"height over datum in m");
15 N2=30/W+1;
16 N2=round(N2)
17 disp(N2-1,"no. of flight strips");
18 L=(1-pl)*1/S*l/1000;
```

```
19 disp(L,"length of each photograph cover in km");
20 T=3600*L/240.0;
21 disp(round(T),"exposure time in s");
22 Ad=T*240e3/60.0/60.0;//adjusted ground distance
23 N1=40.0e3/Ad+1;
24 N1=round(N1)
25 N=N1*N2;
26 disp(N,"no. of photographs taken");
27 //Part b page 317
28 t=3.0/180*%pi;
29 ya=82.25;
30 xa=-62.45;
31 s=220;
32 f=152.4;//focal length
33 H=2500.0e3;
34 h=500.0e3;
35 //calculation
36 theta=s-180;
37 ya_dash=xa*sin(theta*%pi/180)+ya*cos(theta*%pi/180)+
     f*tan(t)
38 S=(f/cos(t)-ya_dash*sin(t))/(H-h);
39 disp(round(1/S),"scale of photograph in 1 in")
40 disp("answer varies slightly due to round off error"
     )
41 clear()
```

Scilab code Exa 6.13 82

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 t=3*%pi/180;//tilt
5 xa=-62.45;//x coordinate of a
6 xb=78.25;//x coorbinate of b
7 f=152.4;//focal length in mm
```

```
H=2500.0;//actual height in m
hb=800;//height B in m
ha=500.0;//height A in m
ya=82.25;//y coordinate of a
yb=-41.15;//y coordinate of b
s=220.0;
//calculation
theta=s-180;
ya1=xa*sin(theta*%pi/180)+ya*cos(theta*%pi/180)+f*
   tan(t);//ya'
xa1=xa*cos(theta*%pi/180)-ya*sin(theta*%pi/180);//xa
   '
xb1=xb*cos(theta*%pi/180)-yb*sin(theta*%pi/180);//xb
   '
yb1=xb*sin(theta*%pi/180)+yb*cos(theta*%pi/180)+f*
   tan(t);//yb'
Xa=xa1*(H-ha)/(f/cos(t)-ya1*sin(t));
Xb=xb1*(H-hb)/(f/cos(t)-yb1*sin(t));
Ya=ya1*cos(t)*(H-ha)/(f/cos(t)-ya1*sin(t));
Yb=yb1*cos(t)*(H-hb)/(f/cos(t)-yb1*sin(t));
AB=sqrt((Xb-Xa)**2+(Yb-Ya)**2);
disp(AB,"distance of AB in m")
clear()
```

Scilab code Exa 6.14 83

```

clc; funcprot(0);
// Initialization of Variable
ri=95.0;//radial distance in mm
f=152.4;//focal length in mm
t=3*%pi/180;//tilt
l=50*%pi/180;//angle
//calculation
dt=ri**2*sin(t)*cos(l)**2/(f-ri*sin(t)*cos(l));
```

```
10 disp(round(dt*100)/100,"tilt displacement of the
     image in mm")
11 clear()
```

Scilab code Exa 6.15 84

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 d=230.0;//square side in mm
5 f=152.4//focal length in mm
6 pl=0.6;//end lap
7 //calculation
8 k=(1-pl)*d/f;
9 V=k/0.15;
10 disp(V,"vertical exaggeration is")
11 clear()
```

Scilab code Exa 6.16 85

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 xa=51.23;//x coordinate of a
5 xb=91.48;//x coordinate of b
6 ya=48.33;//y coordinate of a
7 yb=-51.63;//y coordinate of b
8 f=152.4;//focal length in mm
9 B=425.0;//actual height in mm
10 hb=842.86//height B in mm
11 ha=820.97;//height A in mm
12 r1=10.42;//in mm
13 r2=9.67;//in mm
```

```
14 b1=89.12;//base in mm
15 b=89.43;//base in mm
16 ra=11.62;//parallax in mm
17 rb=14.53;//parallax in mm
18 //calculation
19 C=0.5*((b1-r1)+(b-r2))
20 pa=C+ra;
21 pb=C+rb;
22 Xa=B*xa/pa;
23 Xb=xb*B/pb;
24 Ya=ya*B/pa;
25 Yb=yb*B/pb;
26 AB=sqrt((Xb-Xa)**2+(Yb-Ya)**2);
27 disp(AB,"distance of AB in m")
28 disp("the answer does not match with textbook due to
       round off error")
29 clear()
```

Scilab code Exa 6.17 86

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 C=79.0;//in mm
5 ra=11.42;//elevarion in image in mm
6 rb=15.65;//elevarion in image in mm
7 hb=651;//height of B in mm
8 H=1500;//height in m
9 //calculation
10 delp=ra-rb;//pa=ra+c and pb=rb+c so ra-rb=pa-pb
11 pa=ra+C;
12 ha=hb+delp/pa*(H-hb);
13 disp(ha,"height of A in m")
14 clear()
```

Scilab code Exa 6.18 77

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 B=741.0;//airbase in m
5 f=152.4;//focal length in mm
6 pa=94.32;//in mm
7 ha=325;//elevation in mm
8 //calculation
9 H=ha+B*f/pa;
10 disp(H,"height in m")
11 clear()
```

Scilab code Exa 6.19 88

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 H=1632.0;//above MSL in m
5 f=152.4;//focal length in mm
6 pa=82.75;//in mm
7 ha=283;//elevation in m
8 //calculation
9 B=pa/f*(H-ha);
10 disp(B,"width of air base in m")
11 clear()
```

Scilab code Exa 6.20 89

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 alpha=50.0;//angle in degrees
5 beta=46.0;//angle in degrees
6 f=300.0;//focal length in mm
7 xa=24.0;//x coordinate of a
8 xb=30.0;//x coordinate of b
9 //calculation
10 dela=xa/f;
11 delb=xb/f;
12 A=alpha+dela*180/%pi;//angle A
13 B=beta-delb*180/%pi;//angle B
14 D=180-A-B;
15 AD=1300.0*sin(B*%pi/180)/sin(D*%pi/180);
16 disp(round(AD),"distance of AD in m");
17 Y=6/(sqrt(xa**2+f**2))*AD;
18 RD=60.12+Y;
19 disp(RD,"RL of D in m");
20 disp("the answer varies slightly due to round off
     error");
21 clear()
```

Scilab code Exa 6.21 90

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 f=152.4;//focal length in mm
5 L=120;//length in m
6 x1=40.0;//distance in mm
7 x2=-90.0;//distance in mm
8 //calculation
9 X=f*L/(x1-x2);
10 disp(X,"the coordinates of D in m is X=")
```

```
Y=L*x1/(x1-x2);
disp(Y,"the coordinates of D in m is Y=")
h=X*(30-20)/f;
disp(h,"elevation of D in m")
clear()
```

Scilab code Exa 6.22 91

```

clc; funcprot(0);
// Initialization of Variable
function[dms]=degtodms(deg)
    d = int(deg)
    md = abs(deg - d) * 60
    m = int(md)
    sd = (md - m) * 60
    sd=round(sd*100)/100;
    if sd==60.0 then
        sd=0;
        m=m+1;
    end
    dms=[d m sd]
endfunction
f=150.4;//focal length in mm
xc=-32.43;//coordinate in mm
xd=9.52;//coordinate in mm
//calculation
thc=atan(xc/f);
thd=atan(xd/f);
th=thd-thc;
th=th*180/%pi;
Az=325+15.0/60+th;
Az=degtodms(Az);
disp(Az,"Azimuth of D in deg,min,sec respectively")
disp("the answer differs slightly due to round off
```

```
    error")
28 clear()
```

Scilab code Exa 6.23 92

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 BC=66.0;//distance in m
5 AC=81.6;//distance in m
6 xb=3.0;//x coordinate of b
7 ya=1.25;//y coordinate of a
8 xa=3.3;//x coordinate of a
9 theta=23+43.0/60;//angle in degrees
10 //calculation
11 f=(xa+xb)/2/tan(theta*%pi/180)+sqrt((xa+xb)**2/4/(
     tan(theta*%pi/180))**2+xa*xb);
12 disp(round(f),"focal length in cm");
13 aa=atan(ya/sqrt(xa**2+f**2));
14 Va=AC*tan(aa);
15 ab=atan(-1.87/sqrt(xa**2+f**2));
16 Vb=-BC*tan(ab);
17 disp(round((Vb+Va)*100)/100,"horizontal distance in
     m");
18 disp("the answer varies slightly due to round off
     error");
19 clear()
```

Scilab code Exa 6.24 93

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
```

```
4  Eab=300.0;//average elevation
5  f=152.4;//focal length in mm
6  xa=28.4;//x coordinate of a
7  xb=-22.5;//x coordinate of b
8  ya=24.5;//y coordinate of a
9  yb=38.4;//y coordinate of b
10 Ha=2322.0;//distance in m
11 ha=400.0;//elevation of a in m
12 hb=200.0;//elevation of b in m
13 ab=61.05;//distance in mm
14 AB=810;//ground length in m
15 //calculation
16 Ha=300+AB/ab*f;
17 Xa=round((Ha-ha)*100/f*xa)/100;
18 Xb=round((Ha-ha)*100/f*xb)/100;
19 Ya=round((Ha-hb)*100/f*ya)/100;
20 Yb=round((Ha-hb)*100/f*yb)/100;
21 AB=sqrt((Xa-Xb)**2+(Ya-Yb)**2);
22 disp(round(AB*100)/100,"length AB in m");
23 H=300+810/AB*(Ha-Eab);
24 Xa=(H-ha)/f*xa;
25 Xb=(H-ha)/f*xb;
26 Ya=(H-hb)/f*ya;
27 Yb=(H-hb)/f*yb;
28 AB1=sqrt((Xa-Xb)**2+(Ya-Yb)**2);
29 disp(AB1,"corrected length AB in m");
30 disp(round(H*1000)/1000,"flying height in m");
31 //Xb is calculated wrong in the book that resulted
     in the error-
32 clear()
```

Scilab code Exa 6.25 94

```
1
2  clc; funcprot(0);
```

```
3 // Initialization of Variable
4 AB=300.0;//length in m
5 ab=102.4;//distance in mm
6 f=152.4;//focal length in mm
7 hab=320.0;//average elevation in m
8 d=7.8;//dispalcement in mm
9 r=75.4;//distance in mm
10 //calculation
11 H=hab+AB/ab*f;
12 h=d*H/r;
13 disp(h,"height difference in m")
14 clear()
```

Scilab code Exa 6.26 95

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 f=152.4;//focal length in mm
5 b=74.25;//distance in mm
6 ht=100.0;//height in m
7 H=700.0;//flying height
8 //calculation
9 B=b*H/f;
10 pb=f*B/H;
11 pt=f*B/(H-ht);
12 delp=pt-pb;
13 disp(round(delp*100)/100,"error due to parallax in
   mm")
14 ht=delp/pt*(H);
15 disp(ht,"height of chimney in m")
16 clear()
```

Scilab code Exa 6.27 96

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 B=180.0;//height in m
5 f=120.0;//focal length in mm
6 pa=54.32//parallax in mm
7 pb=46.35;//parallax in m
8 //calculation
9 delH=B*f/pa/pb*(pa-pb);
10 disp(delH,"height difference in m")
11 clear()
```

Scilab code Exa 6.28 97

```
1
2 clc; funcprot(0);
3 // Initialization of Variable
4 L1=30000.0;//length in m
5 pl=0.6;//overlap
6 k=12000.0*0.2;//=l/S and w/S
7 pw=0.3;//side lap
8 W1=24000;//width in m
9 //calculation
10 N=round(((L1/((1-pl)*k)+1)+1))*round(((W1/((1-pw)*k)
   +1)+1));
11 disp(N,"no. of photographs taken");
12 Nf=N/33-1;//flight strips
13 disp(Nf,"no. of flight strips");
14 gd=(1-pl)*k;//grounf distance
15 disp(gd,"ground distance in m");
16 I=gd/(200e3)*60.0*60.0;//exposure interval
17 disp(round(I),"exposure interval in s");
18 ad=round(I)/60.0/60*200e3;//actual distance
```

```
19 disp(ad,"actual distance in m");
20 clear()
```