

用EXCEL处理高斯坐标计算问题

吕建国

(安徽省煤田地质局第三勘探队, 安徽 宿州 234000)

摘要: 本文介绍了使用EXCEL处理高斯坐标的正算、反算问题, 着重阐述了计算公式的编制, 具有使用方便、实用性较强的特点。

关键词: EXCEL; 高斯坐标; 地理坐标; 正算; 反算

中国分类号: TP317.3

文献标识码: A

0 引言

在地质勘探、地形图测绘和公路、铁路等工程施工中, 经常涉及地理坐标与高斯坐标的换算, 即高斯投影坐标计算, 包括高斯投影正算和高斯投影反算。无论是正算还是反算, 为了确保精度要求, 常常会用到高阶导数(一般算至六阶)按照公式计算, 或者使用《高斯、克吕格投影计算表》进行计算, 不管是利用公式计算还是查表计算, 计算都比较复杂, 而且精度较低, 容易出错, 计算速度慢。随着计算机的广泛应用, 利用EXCEL电子表格计算, 不仅速度快而且精度高。

1 正算

高斯投影正算是由地理坐标(L, B)求高斯平面坐标(X, Y)。

地理坐标的单位一般是由度分秒组成的, 而EXCEL中角度单位是弧度制, 所以首先必须将以度分秒为单位的坐标转换为以弧度为单位的坐标。在EXCEL工作簿中分别建立正算和反算两个工作表, 如下图1所示, 在B2、C2两个单元格中分别输入纬度和经度坐标, 特别注意, 输入纬度和经度的坐标是以度为整数位, 小数点后两位为十分位和分位, 十分位和分位是零的用0补齐, 分位后为秒位。为了便于说明, 对建立的每个单元格公式按表1进行说明:

2 反算

高斯投影反算是由高斯平面坐标(X, Y)求地理坐标(L, B)。

建立反算工作表后, 在B2、C2单元格中分别输入X、Y值, 象正算一样, 按照高斯投影反算公式逐个建立单元格公式, 如表2所示:

	A	B	C	D	E	F	G	H	I	J
1	序号	B	L	B1	L1	L0	I	N	X	Y
2	0	32.24576522	118.54152206	32.41601450	118.90422794	20	0.03323505	6384387.96062077	3589644.285	2067913
3										
4	1									
5										

图1 EXCEL工作簿中分别建立正算和反算两个工作表

Fig.1 Separate establishment of positive and reverse calculation work table in EXCEL workbook

收稿日期: 2010-08-16

作者简介: 吕建国 (1967-), 男, 安徽六安人, 工程师, 现从事煤田地质测绘工作。

表1 高斯正算单元格公式说明
Table 1 Notes on Gauss positive calculation cell formula

单元格代码	公式或输入内容	单元格说明
A2	输入点名或代号	
B2	输入纬度	
C2	输入经度	
D2	$=\text{INT}(B2)+(\text{INT}(B2*100)-\text{INT}(B2)*100)/60+(B2*10000-\text{INT}(B2*100)*100)/3600$	角度单位转换，即以度分秒形式转换为以弧度为计算单位
E2	$=\text{INT}(C2)+(\text{INT}(C2*100)-\text{INT}(C2)*100)/60+(C2*10000-\text{INT}(C2*100)*100)/3600$	求出6°分带带号
F2	$=\text{INT}((E2+6)/6)$	求出经差
G2	$=(E2-F2*6+3)*3600/206264.8063$	纬度余弦值
H2	$=\text{COS}(D2*3.1415926536/180)$	
I2	$=6399698.902-21562.267*\text{POWER}(H2,2)+108.973*\text{POWER}(H2,4)-0.612*\text{POWER}(H2,6)+0.004*\text{POWER}(H2,8)$	公式计算处理
J2	$=32140.404-(135.3302-(0.7092-0.004*H2*H2)*H2*H2)*H2*H2$	
K2	$=(0.25+0.00252*H2*H2)*H2*H2-0.04166$	
L2	$=(0.166*H2*H2-0.084)*H2*H2$	
M2	$=(0.3333333+0.001123*H2*H2)*H2*H2-0.1666667$	
N2	$=0.0083-(0.1667-(0.1968+0.004*H2*H2)*H2*H2)*H2*H2$	
O2	$=6367558.4969*D2*3600/206264.8063-(J2-(0.5+(K2+L2*G2*G2)*G2*G2)*G2*G2)*\text{SIN}(D2*3.1415926536/180)*H2$	输出高斯坐标X值
P2	$=F2*1000000+500000+(1+(M2+N2*G2*G2)*G2*G2)*G2*I2*H2$	输出高斯坐标Y值

表2 高斯反算单元格公式及说明
Table 2 Notes on Gauss reverse calculation cell formula

单元格代码	公式或输入内容	单元格说明
A2	输入点名或代号	
B2	输入X值	
C2	输入Y值	
D2	$=\text{INT}(C2/1000000)$	
E2	$=(B2/6367558.4969)*206264.8063$	
F2	$=\text{COS}((E2/3600)*\text{PI}()/180)*\text{COS}((E2/3600)*\text{PI}()/180)$	
G2	$=E2+(50221746+(293622+(2350+22*F2)*F2)*\text{POWER}(10,-10)*\text{SIN}((E2/3600)*\text{PI}()/180)*\text{COS}((E2/3600)*\text{PI}()/180)*206264.8063$	
H2	$=\text{COS}((G2/3600)*\text{PI}()/180)*\text{COS}((G2/3600)*\text{PI}()/180)$	
I2	$=6399698.902-(21562.267-(108.973-0.612*H2*H2)*H2*H2$	
J2	$=(C2-(D2*1000000)-500000)/(I2*\text{COS}((G2/3600)*\text{PI}()/180))$	
K2	$=(0.5+0.003369*H2)*\text{SIN}((G2/3600)*\text{PI}()/180)*\text{COS}((G2/3600)*\text{PI}()/180)$	
L2	$=0.333333-(0.166667-0.001123*H2)*H2$	
M2	$=0.25+(0.16161+0.00562*H2)*H2$	
N2	$=0.2-(0.1667-0.0083*H2)*H2$	
O2	$=\text{INT}(O2/3600)+\text{INT}((O2/3600-\text{INT}(O2/3600))*60)/100+(O2/60-\text{INT}(O2/60))*60/10000$	输出地理坐标纬度值，以度分秒的形式。
P2	$=D2*6-3+\text{INT}(P2/3600)+\text{INT}((P2/3600-\text{INT}(P2/3600))*60)/100+(P2/60-\text{INT}(P2/60))*60/10000$	输出地理坐标经度值，以度分秒的形式。

3 几点说明

(1) 3°投影时，可以根据中央子午线计算公式对正算工作表中F2单元格和反算工作表中R2单元格作如下修改即可利用：

$$F2=\text{INT}((E2+1.5)/3)$$

$$R2=D2*3+\text{INT}(P2/3600)+\text{INT}((P2/3600-\text{INT}(P2/3600))*60)/100+(P2/60-\text{INT}(P2/60))*60/10000$$

(2) 无论是正算还是反算，往往需要换算的点位不止一个，我们可以用单元格填充柄很方便地进行填

充，正算时对D至N列单元格填充，反算时对D至R列单元格填充，计算时只需在B列、C列输入已知参数，在正算工作表中，从O列、P列中分别得到相应的X、Y值，在反算工作表中，可以在Q列、R列分别得到相应的地理坐标B、L的值。对单元格填充可以很方便地达到批量计算的目的，大大提高了工作效率。

(3) 采用EXCEL公式计算，不仅计算方便，出错率很低，而且精度较高，正算时其误差不超过±0.5m，反算时地理坐标的误差达到±0.001”。

(下转P80页)

徽省庐江县泥河铁硫矿床地质特征及成因初步分析[J]. 地质学报, 2011, 85(5):789 ~ 801

[7]吴明安,汪青松,郑光文,蔡晓兵,杨世学,狄勤松.安徽庐江泥河铁矿的发现及意义[J].地质学报, 2011, 85(5):802 ~ 809

THE LU-ZONG IRON-COPPER INTEGRATED EXPLORATION ZONE IN ANHUI PROVINCE A SUCCESSFUL EXAMPLE IN INNOVATION OF NEW ORE-PROSPECTING MECHANISM

LU San-ming¹, LI Jian-she¹, BAI Lin², LOU Jin-wei¹, WANG Qing-song³

(1. Public Geological Survey Management Center of Anhui Province, Hefei, Anhui 230001, China; 2. Bureau of Geology and Mineral Exploration of Anhui Province, Hefei, Anhui 230001, China; 3. Institute of Exploration Technology of Anhui Province, Hefei, Anhui 230031, China)

Abstract: The Lujiang-Zongyang area is the only ministerial-level integrated exploration zone and has undergone three major stages from ore-prospecting works to four-party exploration and integrated exploration, and brought the Nihe Mode into being, represented by major breakthroughs in fundamental geology, sci-tech innovation and deep ore prospecting. Successful practices include integrated exploration linkage mechanism, sci-tech lead and support, scheme instruction and fundamental geological work strengthening, funding guide and pull, effective incentive mechanism and mineral title management innovation mechanism. The experience and mode of the Lu-Zong iron-copper integrated exploration zone have promoted innovation of ore prospecting mechanism in the province and the country. Another highlight of the experience in integrated exploration is from the Wuhe area, Anhui Province.

Keywords: ore prospecting works; integrated exploration; demonstration; the Lu-Zong area

(上接 P71 页)

(4) 打印输出时, 可以将计算过程进行隐藏, 即对正算工作表中 D 至 N 列隐藏, 反算工作表中的 D 至 R 列隐藏, 同时对输出表格进行适当美化。

参考文献:

[1]张凤举.控制测量[M].北京:煤炭工业出版社,1997.

[2]武汉测绘科技大学.测量学[M].北京:测绘出版社,1995.

EXECL USED TO DEAL WITH GAUSS COORDINATES ALGORITHM

LU Jian-guo

(No.3 Exploration Team of Bureau of Coal Geology of Anhui Province, Suzhou, Anhui 234000, China)

Abstract: This paper introduced use of EXCEL to deal with positive and reverse calculations for Gauss coordinates, and underscored the preparation of calculation formula. It is convenient and very practical.

Keywords: EXCEL; Gauss coordinates; geographical coordinates; positive calculation; reverse calculation

(上接 P67 页)

育林, 减轻水土流失。

参考文献:

[1]泥石流灾害防治工程勘查规范 (DZ/T0220 2006) [S].

[2]泥石流灾害防治工程设计规范 (DZ/T0239 2004) [S].

[3]工程地质手册 (第四版) [S].

[4]砌体结构设计规范 (GB5004 2001) [S].

[5]四川省中小流域暴雨洪水计算手册 (四川省水利电力厅) [S].

FEATURES OF FLOOD-DITCH MUD-ROCK FLOW AND THE DESIGN OF PREVENTIVE AND TREATMENT WORKS IN THE EARTHQUAKE-HIT AREA OF AN COUNTY, SICHUAN

CHU Chang-fu, HU Ling

(No.321 Geological Team of Bureau of Geology and Mineral Exploration of Anhui Province, Tongling, Anhui 244033)

Abstract: The Sichuan "5.12" great earthquake seriously damaged local geological environment and brought about many places of geological hazards. This paper analyzed formation mechanism, distribution, natures and features of flood-ditch mud-rock flows in the earthquake-hit areas, measured and estimated reserve of solid material source, made a calculation in detail of nature parameter of mud-rock flow, conducted design calculation for preventive and treatment works, and finally put forward the key points in design based on example works and experience.

Keywords: mud-rock flow; hazard; features; prevention and treatment; design