

# 全站仪内存记录导线观测数据的数据处理系统开发

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摘要:在导线测量外业观测过程中,采用全站仪内存进行电子记簿,针对其数据记录功能进行导线观测值提取、计算功能的二次开发,并做了相应的数据处理;充分利用其编码测量的功能,开发相应的数据处理程序模块,自动提取数据并转换成平差软件能识别的标准的统一的平差文件,减轻了劳动强度和减少了内、外业的工作量。

关键词:导线测量;观测值;内存记录;数据处理

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传统的导线控制测量是用仪器在野外测量水平角、垂直角、距离等,常采用人工记录方式。随着激光技术、电子技术、计算机软硬件技术的发展,产生了测距仪、全站仪等光电结合型的测绘仪器,传统测绘方法因此而发生了巨大的变化。有了全站仪等先进测量仪器和计算机技术的大力支持,我们就可以建立三维数据自动采集、传输、处理的测量数据处理系统,将传统的手簿记录、手工录入、繁琐计算等大量工作交由计算机处理,由计算机控制各项限差,在减轻工作人员工作强度的同时提高工作效率,加快作业速度,测量精度也得到了保证和提高。

## 1 数据处理程序的设计

### 1.1 数据采集及转换的流程

使用全站仪进行导线测量(以图根导线为例)的数据处理流程,主要包括两部分内容:一是外业数据采集部分,在制定数据采集编码规则后,进行外业数据采集;二是内业数据处理部分,是针对外业采集形成的多种数据进行转换计算,平差后得到最终控制成果。

### 1.2 数据处理软件的功能设计

使用全站仪内存进行记录测量,若要使外业采集数据能够灵活处理,需要充分利用编码功能,制定相应的规则,在外业观测时输入相应的编码,软件通过识别这些编码达到记录计算导线观测值的目的。软件的主要功能包括5个模块(如图1所示);还有4个辅助的模块,分别为文件操作、数据格式转换、成果表格输出和其他项。

## 2 数据处理软件的开发和实现

全站仪记录导线功能的实现需要分两步走,首先需要将不同数据格式的导线记录观测值转换成统一的

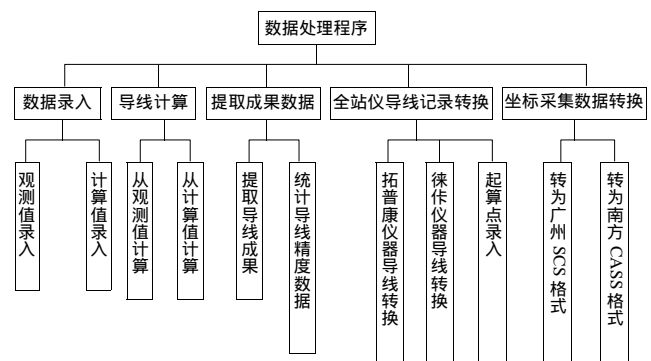


图1 数据处理模块原理结构图

格式,然后通过计算模块对导线观测数据进行计算,提供给后续工作使用。这样设计的目的,一是在计算模块不用重复工作,二是有利于程序的可拓展性,为其他类型仪器的数据使用提供便利,仅需要将其数据格式转换为统一的数据格式,即能被本程序应用。

### 2.1 外业导线测量编码规则的设定

全站仪记录测量数据包括观测数据和坐标数据,要实现导线测量就要利用观测数据,全站仪内存的观测数据只是按照观测顺序进行记录的一系列数据,并不区分哪些记录是导线观测数据,哪些是细部点观测数据,这就需要在野外测量时对观测数据标识不同的编码来区分数据的性质,然后利用编写的软件对这些数据进行读取、分析、计算。

以拓普康全站仪为例,通过在属性编码的位置输入以下字符,对拓普康全站仪的导线记录标志作定义,则其他编码均作为细部点来处理。

导线起始标志:在测站的属性位置输入“20”;  
盘左归零标志:在细部点测量数据的属性位置输入“10”;  
盘左前视标志:在细部点测量数据的属性位置输入“11”;  
盘右前视标志:在细部点测量数据的属性位置输入“12”;  
盘右归零标志:在细部点测量数据的属性位置输入“13”;  
测站结束标志:观测数

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据已可以区分测站数据,不用输入; 导线结束标志: 在测站的属性位置输入“25”。

数据格式举例如下:

STN V1,1.543,20
BS V0,1.290,10
HD 359.59590,81.6860, -0.3210
.....

在上例中,拓普康全站仪的数据以行为单位,数据之间用逗号分割,表示的含义如下:

在“STN V1,1.543,20”行中,“STN”表示测站;“V1”是测站点名称;“1.543”是仪器高;“20”表示导线开始。

“BS V0,1.290,10”与“HD 359.59590, 81.6860, -0.3210”两行代表定向观测数据,“BS”表示后视定向;“V0”是定向点名称;“1.290”是定向点棱镜高;“10”表示盘左定向归零;“HD”表示平距观测模式,如果是“SD”表示斜距观测模式;“359.59590”是水平角观测值,“81.6860”是平距测量值,“-0.3210”是观测高差。

其他数据与以上叙述类似,在此不一一列举。

2.2 导线平差文件的定义

针对导线数据格式定义了3种形式:前视观测高差,对向观测高差,计算后的导线数据。导线计算部分针对两种情况编写了计算模块,的计算是通过转换为或,然后再使用相应的功能计算。

虽然导线平差数据文件有3种格式,但都是以行为单位,每一行代表一组数据,每行前2个字符的含义为:“11”表示导线起始定向点数据,“12”起始测站点数据,“13”表示闭合测站点数据,“14”表示闭合定向点数据,“20”表示测站观测值数据,“30”表示细部点观测数据。

1) 记录前视观测高差数据的导线平差文件。前视观测高差数据的导线平差文件包括测站序号、点名、盘左水平角归零、盘左水平角观测值、盘右水平角观测值、盘右水平角归零、盘左平距、盘右平距、仪器高、前视镜高。具体格式如下:

11 TI859 4383252385 468885250 13464
12 TI858 4383291641 469047338 13344
13 TI856 4382831225 468993419 8712
14 TI857 4383143009 469037786 10144
20 1 TI858 0 2862601 1062543 1795948
132257 132259 -2871 -2883 1562 1440
20 2 A217-1 0 1840122 40112 1795944
41906 41906 -789 -792 1440 1520
.....

30 1 TI858 1 3581835 165873 1 -177
1180

2) 记录对向观测高差数据的导线平差文件。对向观测高差数据的导线平差文件包括测站序号、点名、盘左水平角归零、盘左水平角观测值、盘右水平角观测值、盘右水平角归零、前视盘左平距、前视盘右平距、仪器高、前视镜高、后视盘左平距、后视盘右平距、仪器高、后视镜高。具体格式如下:

11 TI859 4383252385 468885250 13464
12 TI858 4383291641 469047338 13344
13 TI856 4382831225 468993419 8712
14 TI857 4383143009 469037786 10144
20 1 TI858 0 2862601 1062543 1795948
132257 132259 -2872 -2883 1562 1440
20 2 A217-1 3595958 1840122 40112
1795944 41906 41906 -790 -793 1440 1520
132257 132257 2863 2882 1440 1562
.....

3) 观测值计算后的导线平差文件。计算后的导线平差文件包括测站序号、点名、水平角中数、平距中数、仪器高、观测高差中数、镜高。具体格式如下:

11 TI825 4381371027 468931596 6990
12 TI851 4381544543 468937324 7825
13 TI852 4381860987 468944387 7847
14 TI853 4382078065 468948301 7617
20 1 TI851 2130742 84494 1527
-340 1495
20 2 A209-1 1495822 52737 1495
-216 1505
.....

2.3 软件的开发与实现

文件菜单中的打开功能和其他菜单功能执行的基础,只有打开数据文件才能够执行相应的功能,本程序的大部分功能都实现了多文件操作的效果,对多文件的相同操作可以操作一次就完成,减少了大量重复操作,如在文本转换、导线平差、导线内存记录转换、提取统计、坐标采集转换时都能够多文档操作。打开多文档操作的源代码如下:

```
CommonDialog1.FileName = ""
'commondialog1.CancelError = False
'允许多种选择+以 Null 作为文件名的分隔符
CommonDialog1.Flags = cdIOFNAAllowMultiselect Or
cdIOFNEExplorer
'筛选文件的过滤器
```

```

CommonDialog1. Filter = "*.org|.org|.zli|.zli|.jsz|
*.jsz|.cgb|.cgb|.dat|.dat|.txt|.txt|.tab|.tab|.xyh|*
. xyh|.dou|.dou|.gsi|.gsi|.gts|.gts|.gcz|.gcz|.dwg|*
. dwg|*. *|. * "
'设定缺省的过滤器
CommonDialog1. FilterIndex = 1
'对话框标题
CommonDialog1. DialogTitle = " 可以选择多个
文件 "
'允许 10KB 的字符数
CommonDialog1. MaxFileSize = 30720
CommonDialog1. CancelError = False

CommonDialog2. FileName = ""
CommonDialog2. Filter = "*.tab|.tab"

Private Sub mnu_open_Click ()
Dim ynn, n, aa, k As Integer
ynn = -1
'On Error GoTo er1
CommonDialog1. Action = 1
If CommonDialog1. FileName = "" Then GoTo er1
ynn = InStr(CommonDialog1.FileName, vbNullChar)
If ynn = 0 Then
strFileNames () = Split ("a a", " ")

'filnamdir = CommonDialog1. FileName
n = Len (CommonDialog1. FileName)
For k = 1 To n
If InStr (k, CommonDialog1. FileName, "\") =
0 Then aa = k - 1: Exit For
Next k
filnamdir = Left$ (CommonDialog1. FileName, aa)

```

```

strFileNames (1) = Mid$ (CommonDialog1. Fil-
eName, aa + 1)
intI = 1
End If
If ynn > 1 Then
strFileNames () = Split (CommonDialog1. FileName,
vbNullChar)
intI = UBound (strFileNames)
If Right$ (strFileNames (0), 1) = "\" Then
filnamdir = strFileNames (0)
Else
filnamdir = strFileNames (0) & "\"
End If
End If
Exit Sub
er1: Label2. Caption = "未打开任何文件 !!! "
End Sub

```

### 3 结 语

数据处理程序已经在多个测区得到应用验证，解决了手工记簿时人工计算限差容易出错的难题，内业计算时自动提取数据，自动转换成标准的统一的平差文件，可直接为平差程序调用，大大减轻了外业劳动强度，减少了内业计算的工作量。

### 参考文献

- [1] 宁津生,陈俊勇,李德仁,等.测绘学概论 [M].武汉:武汉大学出版社,2004
- [2] 陆国胜.测量学(第三版)[M].北京:测绘出版社,1993
- [3] CJJ 8-99.城市测量规范[S].
- [4] GB50026-93.工程测量规范[S].
- [5] 孔祥元,郭际明.控制测量学[M].武汉:武汉大学出版社,2007
- [6] 李青岳,陈永奇.工程测量学[M].北京:测绘出版社,1995
- [7] 武汉测绘科技大学.测量平差基础 [M].北京:测绘出版社,1995

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## 下期论文导读

何宗 张泽烈 蒋陈纯：重庆市主城区建筑物数据库建设初探

从城市精细化管理、城市规划对建筑物信息的迫切需求出发，论述了重庆市主城区建筑物数据库建设的方法、建筑物信息调查采集的途径，开发了主城区建筑物地理信息系统，建立了建筑物信息数据库的动态更新机制，成果广泛应用于城市规划领域，大幅度提升了城市规划管理决策的信息化水平和科学性。

other two methods .

Key words remote sensing image fusion, ALOS, land cover, classification ( Page:116)

Application of ArcGIS Vector Data Spatial Analysis in Urban Apartment Selection by YANG Jing

Abstract This study introduced the buffer analysis and overlay analysis in the spatial analysis of ArcGIS vector data. The two spatial analytic capabilities could be utilized to help potential buyers narrow down suitable zones by classify different zones and analyzing the practical situation in choosing apartments in the urban areas.

Key words spatial analysis, buffer analysis, overlay analysis, zone classification ( Page:119)

Issues of MapGIS to ArcGIS Data Conversion Process

by YANG Xiaochao

Abstract Spatial data conversion is an effective way to increase utilization and reduce duplicate collection of spatial data . Studying the spatial data format conversion can help to significantly improve work efficiency. This paper analyzed the characteristics of MapGIS, ArcGIS software, and explored the problems encountered during the conversion process. It especially analyzed the file corresponding conversion relationship between changes in properties of the field, Figure contour points, and found solutions . It made full use of two complementary advantages of software, so that to maximize sharing of data resources.

Key words MapGIS , ArcGIS , data format conversion ( Page:121)

Topographic Map Scanning Digitization and Precision Analysis Based on CASS7.0 by CHEN Nan

Abstract The topographic map scanning digitization is an important acquisition method for GIS data, which has become the mainstream of the map digitization. This article introduced the scanning digitization's basic principle and the implementation process and with 1:500 existing topographic map for data sources, using professional software CASS7.0 realized the whole production process of the map scanning digitization. It discussed the scanning digital mapping the main error sources and analysed the calibration accuracy and precision of vector in the process of scanning and digitizing.

Key words scanning digitization , gamma correction , precision analysis , CASS7.0 ( Page:124)

MapX-based Mine Hydrogeology Information Management System by LONG Yang

Abstract This paper expounded the overall design of MapX-based Mine Hydrogeology Information Management System, realized the mine hydrogeology data management, maintenance, share and thematic map drawing by using re-development on MapInfo GIS software, the software offered help to hydrogeology information management work.

Key words MapX, GIS, hydrogeology ( Page:127)

Quality Testing Methods of Underground Pipeline Detection Results by XIE Zhiqiang

Abstract In the large area underground pipeline detection data checking process , it fully considered the hidden nature of its detection outcomes. We used scientific procedures, standards, sample control, GIS aids scientific and rational means to improve the efficiency of the inspection and ensure the quality of the outcome.

Key words urban underground pipeline detection, quality characteristics, quality assessment, data quality control ( Page:129)

Design and Data Analysis of Settlement Observation Based on a New Home Construction in Chengdu by LI Yong

Abstract This paper summarized the new project of Jinniu district,

Hou B group (a section of building no. 4) settlement observation engineering basic situation, including the benchmarks laid and detailed discussion of benchmark nets stability, through monitoring data analysis of the building deformation and made corresponding conclusions.

Key words settlement benchmark , data analysis ( Page:132)

Development of Data Processing Systems for Total Station Memory Records Observations by LIU Jiankai

Abstract In the process of traverse field observations, using the electronic record book for total station memory mode, against its data logging functions, we made the extraction of lead observations, the secondary development of computing, and data processing corresponding. Full using of its code measurements function, we developed the data processing module, the extraction of data automatically and converted them to the standard adjustment file that adjustment software could recognize , reduce labor intensity and the workload of outside the inside.

Key words Traverse observations , memory record , data processing ( Page:134)

Application of Chaotic Theory in Deformation Analysis and prediction by LU Jinjin

Abstract Due to environmental factors and instruments impactation , the deformation monitor can be seen as a complex system, and the parameters are uncertain and random, to show the complexity of the nonlinear behavior. The paper used the modern chaotic theory to solve the time series of monitor deformation, and discussed the chaotic theory and prediction method. The example showed that chaotic time series method can get a better accuracy.

Key words deformation monitoring , chaotic time series prediction ( Page:137)

Application Experiment of SmartStation to Cadastral Inventory Based on the Second Investigation of National land

by MEI Xiaodan

Abstract Taking the cadastral inventory of the Sanchahe town in Fuyou county as an example, this paper discussed the application of Leica's SmartStation in cadastral inventory based on the second investigation of national land. By compared the model of Leica's SmartStation without control points with the normal mapping model in accuracy and efficiency, it came to a conclusion that the former was a best way to improve the operational efficiency measurement in field survey . At the same time, this experiment was general and portable , which had a certain importance to make further promotion in the field and space of super-station instruments.

Key words the second investigation of national land , SmartStation , cadastral inventory , accuracy assessment , the mode of location and measurement ( Page:139)

Analyze Chaos of Deformation Monitoring Data

by YUAN Changmao

Abstract This paper described the Lyapunov index method and the correlation dimension method of deformation data, and discussed the calculation of deformation monitoring data Lyapunov exponent and correlation dimension. Finally, it showed a practical example with dam observation data.

Key words deformation monitoring, chaos, Lyapunov exponent, correlation dimension, phase space reconstruction ( Page:142)

Design and Data Analysis of Settlement Observation of Construction by YANG Jianrong

Abstract This paper summarized basic situation of settlement observational engineering which located in longquanyi district south road of