

# 用 Excel VBA 编制变形监测数据处理程序

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**摘要:** Excel 是大家很熟悉的办公软件, 我们在工作中经常会用到。Excel 本身提供了强大的二次开发功能: VBA 具有强大的编程功能。主要介绍了如何利用 Excel VBA 建立一个完整的变形监测系统, 实现监测工作的简捷、快速、准确、自动化。

**关键词:** Excel ; VBA ; 变形监测数据处理分析系统

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随着当今社会科技的不断发展和生产水平的逐步提高, 人们对安全施工的意识也越来越强, 各项监测技术也广泛地应用到各个工程领域和科研工作之中。监测技术水平的高低就成为了衡量国家科技和现代化水平的重要标志之一, 从而使现代监测技术也具有越来越重要的位置。先进精密的监测设备加上稳定、可靠、实用的监测系统, 硬软相结合才能为变形监测工作带来新的突破。变形监测是一个重复性比较强的工作, 对观测质量、精度、数据的快速性、延续性等都有很高的技术要求, 变形监测具有: 周期性重复观测; 监测精度要求高; 综合应用多种观测方法; 数据处理要求严密和快速; 需要多种学科技术的配合等特点。在没有专业软件辅助的情况下, 监测数据处理是很繁琐的事。要进行大批量的反复的数据处理, 既麻烦, 又容易出错。监测过程往往需要在最短的时间内计算处理好大批量的数据, 生成变形曲线图表和相应的分析报表。目前测绘市场上的一些商业软件价格比较昂贵, 另一方面也不一定适合和满足自身工程的需要。笔者从事和负责过多个变形监测项目, 在多年的测量工作中编制了一些实用的监测程序, 解决了一些实际的问题。在长期的变形监测工作中, 发现 Excel 非常适合变形监测工作。它具有强大的数据处理和图表功能, 非常适合监测数据处理。Excel 是微软公司 office 系列办公软件家庭成员中的一部分, 一方面它有强大的数据存储、数据计算处理、分析决策、判断等功能; 另一方面, 它是一个开放的平台, 允许用户使用编程语言开发特定工作需要的应用程序, 利用它自身的 VBA 就可以自己动手编制满足工程需要的变形监测软件系统。本文就以用 Excel VBA 编制沉降变形监测数据处理程序作一论述。

## 1 Excel VBA 程序组件的编制流程

利用 Excel VBA 编制一个方便实用的沉降变形监测数据处理程序并不困难, VBA 程序可以直接人工编写, 也可以通过录制“宏”的方法进行录制。VBA 程序语言的结构和“宏”程序的录制方法可以参看相应的书籍, 这里不再赘述了。本文以沉降监测程序建立的方法为例子进行说明 软件编制的流程图如图 1 所示。

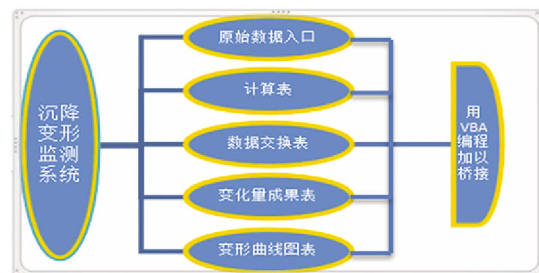


图 1 程序设计流程图

## 2 利用 Excel VBA 设计的用户界面

为了便于作业人员使用, 本程序设置了一个较为简洁的用户界面 (见图 2), 通过点击程序界面设置好的一些按钮, 可以提高人机交互的便利性。



图 2 监测工具界面

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### 3 软件主要功能的实现

#### 3.1 建立专用的 Excel 表格

打开 Excel, 根据自己的需要在其中建立好: 原始记录数据表、计算表、数据传输表、成果表、变形曲线图表等几个工作表。工作表的多少可以根据自己的需要去扩展和命名。另外 Excel 本身具备打开、保存、打印、预览等功能, 不需要另外再去编写这些功能程序, 可以节约开发程序的工作量。

#### 3.2 调入原始观测数据

在用 Excel VBA 编程与原始数据交互时, 可以用多种方式打开数据文件, 比如 Excel VBA 对象: Application.workbooks.opentext 和例程所用的方式或者其他的一些可用的方法。读取原始数据之前, 要对原始数据的格式做好分析和研究, 确保程序能快速、准确地读入数据。原始数据由于篇幅所限, 仅将调入原始数据的主要代码列出来以供参看:

```
Open sFName For Input As #iFNumber '用 Input 方式
打开文件
```

```
Do '读取原始数据
```

```
Input #iFNumber, aStr (1), aStr (2), aStr (3), aStr
(4)
```

```
Input #iFNumber, bStr (1), bStr (2), bStr (3), bStr
(4), bStr (5)
```

```
Loop Until EOF (iFNumber)
```

```
Close #iFNumber '关闭文件
```

#### 3.3 建立观测数据计算表区域

为导入的原始观测数据建立对应的数学模型, 进行计算平差处理。在建立好一定格式的计算表后, 可用 VBA 编写程序, 提取高差、视距等需要的数据; 建立对应的计算模型, 进行闭合差计算、判断各限差合格后, 再平差计算等一系列的工作。以下是计算路线闭合差的主要代码:

```
sumh = 0 '统计闭合差
```

```
For hang = tt To ll Step 4
```

```
hh = Val ((Sheet4. Cells (hang, 8). Text))
```

```
sumh = (sumh + hh)
```

```
Next hang
```

```
UserForm1.TextBox1 = Format(sumh / 100, "0.000000
毫米")
```

#### 3.4 建立数据交换区间表区域

为本次处理好的数据建立一个交换、整理的空间。用 VBA 编程将计算表计算好的高程等数据提取过来进行整理, 计算每次的变形量、累积变形量、沉降速率

等并进行整合。这里可以直接运用 VBA 宏的录制工具直接录制, 然后将录制的宏程序进行编辑就可以了, 具体的录制方法可以参看 Excel 帮助文件。

#### 3.5 建立监测成果表区域

对每个监测周期内的变化量进行统计和汇总。编写 VBA 程序提取数据交换区的数据, 在这里对每个周期的数据进行汇总, 生成变化量汇总表。建立成果表主要代码如下:

```
Private Sub CommandButton1_Click ()
```

```
Do
```

```
h = h + 1
```

```
Loop Until Sheet2. Cells (h, 1) = "闭合差允许值:"
```

```
N = Sheet2. Cells (4, 11)
```

```
For i = 9 To h - 2 Step 2
```

```
If Sheet2. Cells (i, 11) = "*" Then
```

```
A = Sheet2. Cells (i, 1)
```

```
Call HAN (A, T)
```

```
Sheet3. Cells (T, 1) = Sheet2. Cells (i, 1)
```

```
Sheet3. Cells (T, 2 * N) = Sheet2. Cells (i, 8)
```

```
Sheet3. Cells (T, 2 * N + 1) = Sheet2. Cells (i, 10)
```

```
End If
```

```
Next i
```

```
Sheet3. Cells (3, 2 * N) = "本次沉降量"
```

```
Sheet3. Cells (3, 2 * N + 1) = "累计沉降量"
```

```
Sheet3. Cells (2, 2 * N) = Sheet2. Cells (5, 3) &
" " & Sheet2. Cells (4, 11) & "次"
```

#### 3.6 建立变形曲线图表区域

对各变形观测点的变化量自动生成直观的变形曲线图表。利用 VBA 编程实现, 针对每个观测点的变化量数据自动生成: 本次沉降量曲线图表和累计沉降量曲线图表。这里也可以直接运用 VBA 宏的录制工具直接录制, 然后录制的宏程序进行编辑。主要代码如下:

```
ActiveSheet. ChartObjects ("图表 1"). Activate '设置
累计变化量数据源生成曲线图表
```

```
ActiveChart. SetSourceData Source: =Sheets ("图").
Range ("A1: CC" & GetCount + 1), PlotBy: =xlRows
```

```
ActiveSheet. ChartObjects ("图表 2"). Activate
```

```
ActiveChart. SetSourceData Source: =Sheets ("图").
Range ("A" & GetRow & ": CC" & GetRow + GetCount),
PlotBy: =xlRows
```

#### 3.7 成果分析

提取各变形观测点的本期沉降量、累积沉降量、沉降速率等进行统计分析, 写出分析文件。由于篇幅所限, 写出分析文件的代码就不在赘述了。

### 4 应用实例

打开编制好的 Excel 监测程序,点击调入原始数据按钮,直接调入原始观测数据。这样可以避免手工输入的错误;然后依次点击程序中的各个按钮,软件自动进行各项数据的计算和处理,生成相应的表格和变形曲线图表。对软件的操作就不一一叙述了,图 3 ~ 图 7 是本程序的沉降监测的成果数据和图表。

沉降观测计算表										
工程名称:		沉降观测		观测方法:		水准测量		观测次数:		5
本次观测时间:		2010/8/2		上次观测时间:		2010/8/1				
起始点号:		1#		闭合(附合)点号:		1#				
起始点高程:		0.4519m								
点名	本次	上次	本次	上次	本次	上次	本次	上次	本次	备注
1#					0.4519	0.4519				
2#	0.10	-0.01395	-0.04	-0.01395	0.4389	0.4389	0.10	0.46	0.56	*
3#	0.18	-0.01399	-0.07	-0.01399	0.4261	0.4259	0.18	0.24	0.22	*
4#	0.21	0.08395	-0.03	0.08395	0.4327	0.4325	0.21	0.33	0.33	*

图 3 沉降观测计算表

广东省地测院院										
沉降观测计算表										
工程名称:		沉降观测		观测方法:		水准测量		观测次数:		5
本次观测日期:		2010/8/2		上次观测日期:		2010/8/1				
点名	本期沉降量	累积沉降量	沉降速率	备注	平差高程	上次高程				
2#	0.10	0.56	0.1021		0.4389	0.4389				
4#	0.18	0.22	0.1845		0.4261	0.4259				
5#	0.21	0.53	0.2071		0.4327	0.4325				
17#	0.14	0.29	0.1355		0.4021	0.4020				
6#	0.02	0.34	0.0193		0.4149	0.4149				
18#	-0.01	0.64	-0.0090		0.3720	0.3720				
19#	-0.03	0.90	-0.0286		0.4070	0.4070				
7#	0.07	0.63	0.0976		0.2525	0.2525				

图 4 沉降监测成果交换表

累计沉降量成果表										
点名	2010/6/30	1次	2010/7/3	2次	2010/7/6	3次	2010/7/15	4次	2010/8/2	5次
3#	0.00	0.00	-0.12	-0.12	0.43	0.32	0.14	0.46		
2#	0.00	0.00	-0.26	-0.26	0.75	0.50				
4#	0.00	0.00	-0.54	-0.54	0.72	0.18	-0.14	0.04		
5#	0.00	0.00	-0.57	-0.57	1.44	0.87	-0.54	0.33		
17#	0.00	0.00	-0.31	-0.31	0.93	0.62	-0.46	0.16		
6#	0.00	0.00	-0.43	-0.43	1.99	1.56	-1.24	0.32		
18#	0.00	0.00	-0.38	-0.38	2.56	2.18	-1.53	0.64		
19#	0.00	0.00	-0.08	-0.08	2.38	2.29	-1.37	0.93		
7#	0.00	0.00	-0.08	-0.08	1.86	1.78	-1.22	0.56		
8#	0.00	0.00	0.04	0.04	2.74	2.78	-1.62	1.16		

图 5 沉降成果统计表

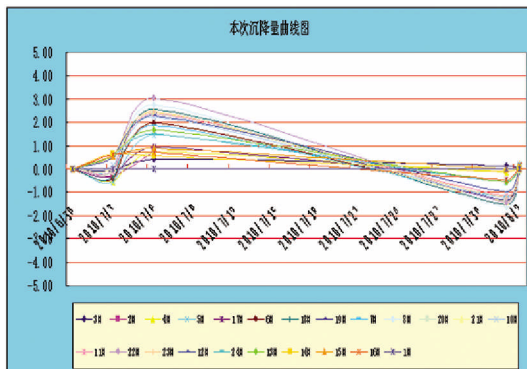


图 6 本次沉降量曲线图

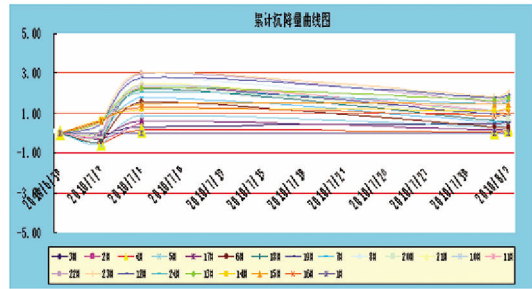


图 7 累计沉降量曲线图

对沉降数据进行处理和生成相应的图表后,点击成果分析按钮,可以对监测点的最大沉降量、变形速率等情况进行提取并写出分析文件。

### 5 结语

近年以来,测量行业已完全进入了全新的数字时代。先进的仪器设备、先进的技术方法,很多方面外业测量仅仅只是一种采集数据的手段,真正要做的是如何处理好那些大批量的数据。在变形监测工作中,同样也会有很多类似的大批量的、反复的、有条理性的数据,这个时候只要能正确应用 VBA,施展其强大的编程功能,编制一个合适的软件系统,就可以完成外业观测和内业数据处理的无缝链接,快速处理数据,在最短时间内完成并达到设计的要求,能够取得事半功倍的效果。

### 参考文献

- [1] 岳建平,田林亚.变形监测技术与应用[M].北京:国防工业出版社,2007
- [2] 高俊强,严伟标.工程监测技术及其应用[M].北京:国防工业出版社,2005
- [3] 朱建军,贺跃光,曾卓乔.变形测量的理论与方法[M].长沙:中南大学出版社,2004
- [4] 马维峰.Excel VBA 应用开发[M].北京:电子工业出版社,2006
- [5] 孙敬杰.Excel VBA 入门与实例演练[M].北京:中国青年出版社,2005
- [6] 李士雨.工程数学基础-数据处理与数值计算[M].北京:化学工业出版社,2005
- [7] 李青岳,陈永奇.工程测量学[M].北京:测绘出版社,1995
- [8] 计算机职业教育联盟. Visual Basic 程序设计基础教程与上机指导[M].北京:清华大学出版社

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**Abstract** Urgent monitoring of earthquake disasters need thematic maps of remote sensing. According to the distribution of the earthquake and the secondary disasters, classifications and coding of disaster information were analyzed. With the national basic scale topographic maps and thematic map symbols of the type, size, color etc separately defined at different scales, it was produced that thematic symbol library of the corresponding earthquake and secondary disasters. Meanwhile, standard for thematic maps of the disaster and the secondary disasters was formed. The templates met the cartography requirements of GIS applications, which can provide accurate disaster information and affected body quickly, and improved the mapping efficiency. It is useful to save time for the rescue and assure the earthquake relief work can be undertaken smoothly.

**Key words** earthquake, the secondary disasters, symbol database, mapping templates (Page:153)

**Preliminary Understanding and Simple Analysis of Numerical Calculation Errors** by LIU Ping

**Abstract** This paper introduced the classification of numerical calculation errors, and used math expressions as examples to illustrate truncation error. According to IEEE754 criterion, this paper used math expressions to explain rounding error. Then this paper simply analyzed the truncation error and rounding error. At last, this paper pointed out attentions in the numerical calculation.

**Key words** numerical calculation, calculation errors, preliminary understanding, simple analysis (Page:156)

**Application of the Second Land Investigation's Result to Daily Land and Resources Management** by XU Yong

**Abstract** This paper introduced the basal informations, technical route, investigating methodology and investigation's result of the WUHAN Second Time Land Investigation, and discussed the applying of the Second Time Land Investigation's result based on the daily Land and Resources Management's requirement.

**Key words** land investigation, land management, cadastral management (Page:159)

**Method for Prediction of Landslide by Phase Space Reconstruction** by XIONG Tianan

**Abstract** In view of the nonlinear characteristics of landslide displacement time sequence, this paper introduced the prediction method based on phase space reconstruction and least squares support vector machine (LSSVM). Used Cao's method to determine the embedding dimension, according to mutual information method to compute the best delay time; Then in the phase space, used least squares support vector machine (LSSVM) to establish the forecast model to compared with LSSVM and the neural network predicting mode. The test result show that the model has the high precision, is scientific and feasible.

**Key words** predictable mode; landslide prediction; phase space reconstruction; least squares; neural network (Page:162)

**Application of SET 1X Total Station Device to Tunnel Through Survey** by CHEN Sansheng

**Abstracts** Combined with the application in Pusagang tunnel through survey of Yalu Highway of SET 1X total station device, elaborated the adoptive ways and technical measurements of tunnel through survey so as to make sure the accurate perforation of the tunnel.

**Key words** total station device, Pusagang tunnel, perforation survey, control survey (Page:165)

**Evaluation of Uncertainty of GPS Receiver Calibration and Calibration Results** by HE Hao

**Abstract** Based on the actual calibration GPS receiver's experience, through the GPS receiver calibration method of in-depth research, with

practical examples, the calibration process problems encountered were analyzed and investigated

**Key words** GPS receiver, Calibration, measuring error, uncertainty (Page:168)

**Establishment of Monitoring Data Processing and Analysis System with Excel VBA Programming** by ZHU Xingang

**Abstract** Excel is popular office software which we often use at work. Excel itself provides a strong secondary development function, VBA, which has powerful programming capabilities. This article described how to use Excel VBA to create a complete deformation monitoring system to realize simple, rapid, accurate and automated monitoring job.

**Key words** Excel, VBA, deformation monitoring data processing and analysis system (Page:170)

**Application of Robotic Total Station in Volume of Vertical Metal Cans** by ZHU Lianghua

**Abstract** The application of robotic total station in volume surveying of vertical metal cans was introduced in this paper. The surveying preparation work, fieldwork, data processing and key technology were discussed detailed combining an example.

**Key words** total station, vertical metal cans, volume surveying (Page:173)

**Matlab and Visual C++ Mixing Programming to Process the Data of the South Total Station** by HU Jiaying

**Abstract** During the indoor work data checking, we often compared the point's field work coordinate with its indoor work coordinate. So we could find if there be some points were artificial, or some points had been moved. At the same time, the processed data could direct provide the three dimension coordinate, it was helpful for the next measure work. This article took the South total station instrument for example, based on matlab and Visual C++ mixing programming to generate the directly executable file, which could separate from the MTALAB environment, then gave the code and the images of the result.

**Key words** MTALAB, hybrid programming, data processing (Page:175)

**Research of Teaching Content in Digital Surveying & Mapping** by MENG Fanchao

**Abstract** Based on the production units of the engineering survey mapping and technical personnel needs, and for "Digital Mapping" characteristics of the course to a topographic mapping of the main line to explore the teaching content and practice, through the constant adjustment and reform to improve Higher engineering professional teaching quality measurement techniques, enhanced their ability and employability and competitiveness.

**Key words** Digital Surveying & Mapping, teaching, research (Page:178)

**Strengthening the teaching of surveying error theory for GIS** by ZHAO Dongbao

**Abstract** Surveying error analysis and treatment is the basic theory which lay a solid foundation for students majored in GIS studying surveying courses, and is also the key to understand surveying principle of various surveying courses. Aiming at the problem that many colleges lacked the uniform plan for surveying error theory course teaching for GIS major students, teaching contents of surveying error theory course for GIS major students were discussed, and teaching schedule was arranged based on characteristic of surveying error theory teaching, and teaching methods of surveying error theory course for GIS major students were listed according to related teaching experience.

**Key words** GIS major, surveying error theory, teaching contents, teaching method (Page:180)