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计算机应用

安庆铜矿水文地质辅助绘图系统的设计与实现

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摘要:文中根据安庆铜矿的具体情况,阐述了水文地质辅助绘图系统的设计与实现。系统的试运行表明:该水文地质管理及辅助绘图系统能够及时、准确、有效地对矿山地质图件进行动态管理,可随时为矿山生产经营决策准确提供各种信息和图表。

关键词: AutoCAD; 水文地质; 辅助绘图系统; 图例

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1 前言

数字矿山(Digital Mining, DM)^[1]主要指应用“3S”等技术,以数字的方式获取、处理和应用关于矿山自然和人文因素的空间数据,并在此基础上解决全国矿山的各种问题。当今, GIS 日益显示其强大的生命力,它的应用已渗透到社会活动每一细节,具有更为广阔的应用前景。但是,在矿山、地质领域的应用却不够理想,至少在国内矿山企业中尚无真正用 GIS 来管理信息、辅助、模拟分析和解决工程问题,但其应用需求却很急迫。

本论文是结合课题“安庆铜矿水文地质数据管理及辅助绘图系统”的研究而撰写的。该项目是根据安庆铜矿现有的基础数据、经济水平、技术人员素质和现有的仪器设备等特点来研究开发一个适用于该矿的水文地质基础数据分析处理的计算机应用系统。安庆铜矿地质储量管理系统运用面向对象的编程软件进行开发,实现矿区各种水文地质数据的有效存储,各种报表的自动生成,水文地质符号、图例及各种曲线图的自动生成等功能。下面着重谈谈水文地质辅助绘图系统的设计与实现。

2 系统的详细设计与实现

2.1 绘制水文地质符号

参考安庆铜矿在绘图生产过程中的实际所要用到的地图符号,在 CAD 模型空间中绘制水文地质符号。绘制的方法分为直接绘制和利用块方法绘制两种。

2.1.1 直接绘制

直接绘制即是在图形空间中添加 AutoCAD 提供的各种图形对象,根据所要用到图形的形状,在程序中组合成一个地图符号。例如绘制坑道流量观测符号的时候,需要用户输入坑道流量的相关数据以及用户选择符号的绘制位置;然后根据得到的数据绘制相应的符号。

2.1.2 用块加入方法绘制

当创建一个块后, AutoCAD 将该块存储在图形数据库中,此后可根据需要多次插入同一个块,而不必重复绘制和储存,因此节省了大量的绘图时间。此外,插入块并不需要对块进行复制,而只是根据一定的位置、比例和旋转角度来引用,因此数据量要比直接绘图小得多,从而节省了计算机的存储空间。因此可以通过这种方法,既节约了时间和资源,又可保证符号的统一性、标准性。在程序中插入块利用的是模型空间的块集合的添加块方法来实现。

以“断层及符号”符号图形的绘制为例说明块加入方法绘制图形的过程:

(1) 绘制图形的程序的编写:

绘制程序的建立过程基本同直接绘制图形的过程相同,不同的是程序在绘制符号图形时不是根据用户的输入坐标在对应的地方绘制图形,而是根据用户的输入坐标在相应的地方插入设计好的块图形。利用一个 Variant 类型变量记录用户选择的点,添加并设置块

```
Set blk = ThisDrawing.Blocks.Add(s, "断层编号") '添加块到块集合中
```

```
Set ll = blk.AddLine(ll_s, ll_e) ..... '在块中插入各图形对象
```

然后在模型空间中加入块图形

```
Dim ref As AcadBlockReference
```

```
Set ref = ThisDrawing.ModelSpace.InsertBlock  
(pt, ""断层编号", 1, 1, 1, 0)
```

(2) 用块加入方法绘制符号程序的效果如下:

①得到符号绘制位置, 参见图1。



图1 提示用户输入断层符号位置的命令窗口

②插入块图形, 参见图2。



图2 制出的断层符号

2.2 绘制水文地质图例

图例的绘制是为了方便在绘图人员绘制图形操作结束以后加入对所绘制的图形的说明解释。本程序除了提供以上绘制的水文地质符号以外, 也加入了用户自定义的图例图形的功能, 使绘图操作人员在完成工作以后快速的生成说明的图例, 提高绘图的准确性, 减少人工操作的误差和重复性劳动。

2.2.1 程序自带的图例

在上面绘制的水文地质符号中, 所有的图形都放在一个 ImageList 控件中在程序运行时调用, 在程序第一次调用时在程序运行目录下生成图片存储的目录, 程序运行以后通过用户的选择选取相应的图片插入到模型空间中生成图例。

(1) 绘制自带的图形的程序的主要函数

在程序运行窗体上几个主要的控件如下表1。

表1 绘制自带图例程序控件列表

名 称	类 型	说 明
Lst1	ListBox	自带的图形符号
Lst2	ListBox	要绘制的图形符号
Lst3	ListBox	用户自定义符号
Lst4	ListBox	要绘制的自定义符号
cb_self	CommandButton	显示用户自定义符号
CB_OK	CommandButton	绘制图例
Lb_BeiShu	Label	图形的放大倍数
Lb_JianJu	Label	图例图片之间的间距
IL_1	ImageList	存储自带的符号图形

(2) 过程

程序运行时, 在程序的初始化过程, 利用过程 AddData2List 中向列表框 Lst1 中加入数据, 利用 FileSystemObject 对象判断是否存在图片目录, 不存

在则利用过程 AddTempDir 建立新的图形目录并储存图形文件。

根据用户选择添加到 Lst2 中的图形进行绘制, 用户选择确定以后, 调用 HuiZhiTuLi 过程来绘制程序自带的图例。在 HuiZhiTuli 过程中, 先得到用户输入的要绘制图例的点位置, 然后依次绘制用户选择的图例。

2.2.2 用户自定义的图例

用户自定义的图例的图形通过自定义的图例的数据库存储图形文件存放的路径来实现, 自定义图例数据库中存储图例名称和对应的图形文件的路径。自定义图例数据库中保存图例名和图形文件路径的表结构参见表2。

表2 自定义图例数据结构表

字段名	类型	说 明
bmp_path	文本	图形文件存储的路径
Bmp_name	文本	图例的名称

(1) 自定义图例添加的流程如下, 参见图3。

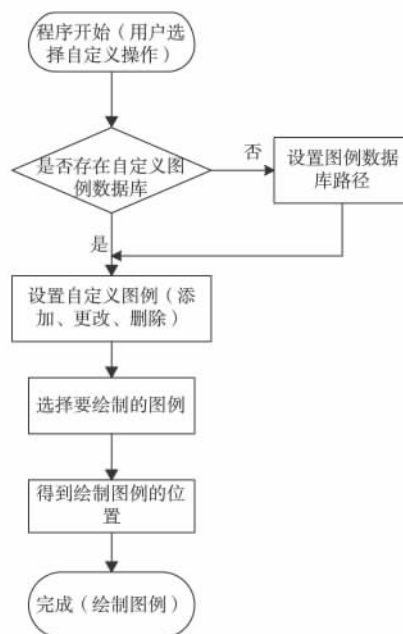


图3 自定义图例添加流程图

(2) 自定义的图例图形绘制的程序的主要函数和过程

在程序运行窗体上几个主要的控件, 参见表3。

用户选择添加自定义图例后自定义图例设置框显示, 如果当前目录下不存在自定义图例数据库, 则要求设置相应的数据库文件。在存在数据库的情况下利用 AddUserBMP2Lst_User 过程将自定义图例数据库中的图形文件添加到列表框中。

表 3 自定义图例绘制程序控件列表

名 称	类 型	说 明
cb_GetUSerBMPPath	CommandButton	设置图例数据库路径
cb_ChangeBMPPath	CommandButton	设置图例图形文件路径
cb_ShanChu	CommandButton	删除选中的图例文件
cb_GengXin	CommandButton	更新当前的图例的设置
cb_JiaRi	CommandButton	新加入图例
DLG1	CommonDialog	图例数据库的存储路径
DLG2	CommonDialog	图例文件的存储路径
lst_BMP	ListBox	显示图例数据库中的图例
Image1	Image	提供图片的预览

在列表中添加图例的名称以后根据所选择的图例进行添加、更新和删除的操作。图例的添加、更新、删除分别利用 JiaRiXinTuLi , GengXinTuLi , Shan-ChuTuLi 过程来完成。得到用户输入后 根据用户选择的自定义图例的符号在模型空间中加入符号图形。

(3) 绘制的图例 参见图 4。

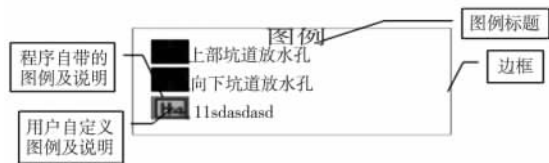


图 4 绘制的图例

2.3 绘制水位动态曲线图

绘制动态曲线图的过程是按照“选取数据来源”，“绘制曲线表格”和“绘制动态曲线”的流程来实现的。通过在 CAD 环境的模型空间依次加上绘图需要的对象来实现整个完整的动态曲线图报表的制作。

2.3.1 程序流程设计

程序运行的主要流程 参见图 5。根据以下的工作流程,可以看到,由于程序按照自顶向下的流程工作,所以可以设置一个能快速上手的用户引导界面来指导用户逐步实现各个步骤。

2.3.2 曲线表格绘制

对于生成的曲线的表格部分主要通过向模型空间添加各种直线和文字对象来实现,主要有 X,Y 轴的轴线以及图形右下角的说明表格。曲线表格的绘制主要通过 HuiTu 过程来实现:

HuiTu 过程的主要代码如下:

```
Public Sub HuiTu( ByVal DBpath As String , ByVal dt_from As Date , ByVal dt_to As Date , bg As BI-  
AOGE , i_UseNum As Integer , str_UserName( ) , Color
```

())
.....

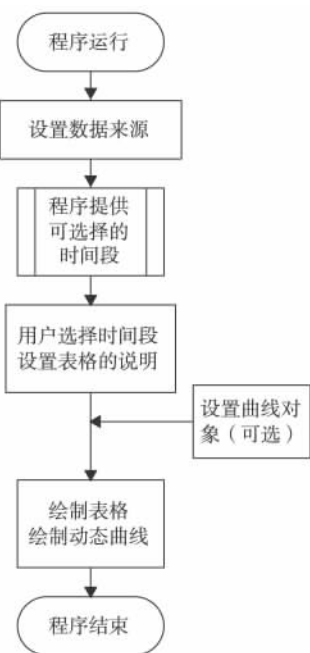


图 5 动态曲线图绘制流程

HuiZhiZuoBiao y_num 绘制坐标和外框

TianJiaBiaoGe bg , 200 + YW * y_num - 90 ,

70 绘制表格

TianJiaWenZi y_num , a2 , bg. TuMing 添加文字

(Y 轴刻度 X 轴日期文字标题)

.....' 绘制动态曲线

UpdateTextFont 设置字体

.....

End Sub

其中 BIAOGE 结构为自定义的一个结构,用来存储说明表格中的数据。

由上面的过程可以看到,在绘图过程中,分别利用不同的过程来实现表格部分的绘制,这样增加了程序模块的独立性,同时使程序的主干流程突出,使程序思路显得清晰,便于以后的修改。

2.3.3 动态曲线的绘制

在绘制由坑道涌水量、钻孔水位的数据所构成的动态曲线时,分别设置一个折线 AcadPolyLine 对象,然后根据读取的数据设置构成折线的各个点的位置,设置折线对象的颜色等即可绘制出曲线图来。

在 HuiTu 过程中绘制了表格以后,通过调用 QuXian_YongShui , QuXian_KuangDian , QuXian_Jian-gYu 来绘制曲线,最后调用 UpdateTextFont 过程设置

字体

过程 QuXian_YongShui, QuXian_KuangDian, QuXian_JiangYu 分别实现从数据库中读取数据并在模型空间绘制涌水曲线、钻孔水位曲线和降雨量分布曲线。

2.4 绘制等水位线

本文通过 VBA 实现基于 AutoCAD 的等值线的自动绘制,功能的实现如下:

- (1) 从数据库中读取离散采样点数据;
- (2) 构三角网;
- (3) 生成等值线。

等水位线图的绘制程序流程图,参见图6。

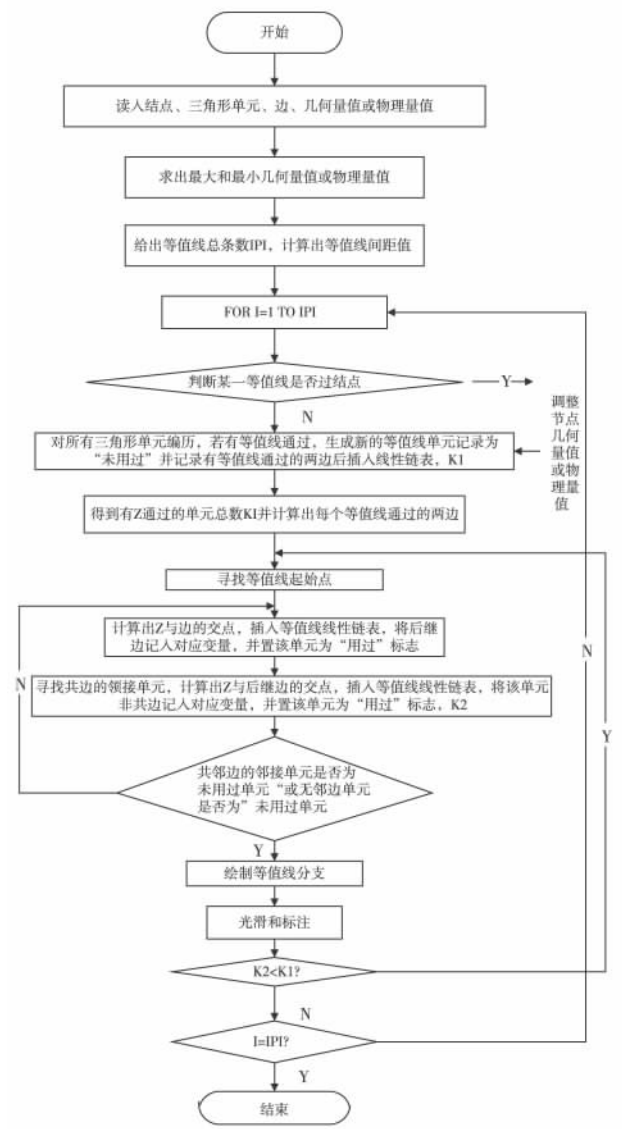


图6 程序流程图

最后成图结果参见图7。

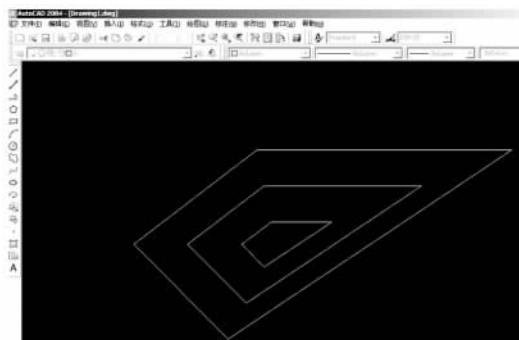


图7 等水位线图成图效果

3 结 语

系统的试运行表明,该水文地质管理及辅助绘图系统能够及时、准确、有效地对矿山地质图件进行动态管理,可随时为矿山生产经营决策准确提供各种信息和图表。充分满足矿山生产对水文地质管理工作的要求,大大提高了水文地质数据管理及成图的工作效率和管理水平。

系统具有一定的通用性,虽然系统研制是针对安庆铜矿的具体情况来进行的,但是对于不同的矿山,由于矿山地质数据的来源、利用地质数据绘制的图件及其地质资料的使用等方面具有共性,因而系统同样适用于其他矿山。

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ENGLISH ABSTRACTS OF MAIN ARTICLES IN THIS ISSUE

Study on the Ground Subsidence Laws of Fully – Mechanized Mining with Sublevel Caving in Thick Seam —In order to study the surface subsidence deformation under the thick seam fully – mechanized mining , direct mine safety production , the people establish the surface subsidence observation stations above the 5304 fully mechanized caving face in five mining area in Baodian coal and carry out 20 times observations. In the paper , the author obtains the surface subsidence laws and related strata movement parameters under the conditions of fully mechanized coal mining in the area through the analysis of observational data. It provides reliable basis for the " three down" mining in the future and provides scientific reference for mining subsidence control in similar mine. (Li Yunjiang et al.)

Research of Model Test of Surface Movement and Deformation by Mining Coal in loess Mountain Area —It is an important means to study mining subsidence law in the complex geological conditions that the similar material model experiment. In the paper , the author studies the Surface slip deformation characteristics caused by the mountain mining subsidence , reveals the superimposed effect of the mining slopes plastic slip deformation and the normal mining subsidence deformation , reappears the dynamic process of the mining cracks and the surface shear failure in the loess slope , producing an experimental model under the geological and mining conditions in Tongchuan loess mountains in Shanxi. (Gong Yun et al.)

Application of Total Station Trigonometric Leveling in the Shaft Connection Survey of Leading in Height —In the paper , the author introduces the application of total station in leading in height , and describes the principles and operation of the total station trigonometric leveling method in leading in height of the shaft connection survey , and analyzes the accuracy to prove the feasibility of this method , according the connection survey data in a coal mine shaft in Jining City. Practice shows that this method can quickly solve the problem of the deep well leading in height , and it is the characteristic of time shortly , fast speed , high precision , and it has been widely used in the shaft connection survey. (Yu Fengbing et al.)

Transform Participation Heart Coordinate System into CGCS2000 Geocentric Coordinate System Commonly Used in Coalfield Geology Exploration —In the paper , the author introduces the 1954 Beijing coordinate system commonly used in previous survey , 1980 xi 'an coordinate system and national new enable CGCS2000 defined , and their respective advantages and disadvantages , the achievement of 54 , 80 coordinates and the method of transforming the existing drawings into CGCS2000 coordinate system , taking coordinate system conversion problem in SuBei county road – red ShaLiang coal geological engineering exploration measurement for the example. It is the very important practical significance and role. (Dai Youwei)

Practice of Digital Three – dimensional Mine City Platform Construction —In the paper , the author investigates the key technologies in the digital three – dimensional mine city construction in the background of the digital three – dimensional urban platform building in the Jiexiu regional in Fenxi Mining Group Company. The key technologies are the building database of basic geographic information data , the UAV digital aerial triangulation and three – dimensional construction mode. Finally , the author gives the system construction instance interface and the quality control requirements , carries a useful practice for promoting mine urban digital three – dimensional construction. (Wang Xiaoli)

The Construction of 3D GIS System in Beisu Town , Zoucheng , Shandong Province Based on SketchUp and ArcGIS —Using ArcGIS as the platform , and SketchUp as the modeling tool , in the paper , the author develops 3D GIS system in Beisu Town ,

Zoucheng , Shandong Province using VS2008 , achieving 2D , 3D GIS query , browse , and statistical analysis , Contour line automatically generation and submergence analysis and other functions. It meets the need for 3D GIS application system fusing 2D GIS. (Liu Xingwei et al.)

Study on the Analysis and Countermeasure of Geological Disasters Satellite Remote Sensing in Benxi —In the paper , the author investigates and analyzes the geological disasters in mountainous area of Liaodong (east of Nanfen District in Benxi city) by using remote sensing as the main means and combining with the ground survey typical area based on high resolution Quickbird satellite data as main information source , and discovers 25 geological disaster areas. The author put forwards the prevention measures after the feature analysis of these disasters. It provides the basic data and scientific decision – making foundation for the disaster prevention and formulating the plan of regional environmental protection. (Guo Qiushi et al.)

Study on the Land Use Change in Mining Area Based on Quick-Bird Image —In the paper , the author studies the land use change in mining area using remote sensing and geographic information systems (GIS) in 2001 DLG (DLG) and 2005 QuickBird image as a data source. The author quantitatively analyzes the land use change in mining area using the land use structure and the land use diversity index according to the matrix and statistics data of two periods , transition matrix and various land types data during two periods. The results are the following conclusions: (1) Farmland occupation in mining area is still outstanding phenomenon; (2) Land use diversity index of two periods are still low. According to it , the author puts forward some suggestions for the sustainable development of mining areas. It provides the technical supports for the scientific plan and rational use of land in mining areas. (Zhang Hexin)

Literature Review of the SAR Image Speckle – The existence of SAR image speckle noise can seriously affect the SAR image interpretation and subsequent processing , so the research and investigation of smoothing speckle noise have been the international hot. In recent years , a lot of method about SAR image denoising had been developed , in the paper , the author summarizes these methods and analyzes the methods of the latest research status , advantages , disadvantages and applicable scope. It has a certain guiding significance on the next step of the SAR noise work. (Dong Liya et al.)

Design and Implementation of the Hydrographic Geology Assistant Plot System of An – qing Copper Mine —In the paper , the author elaborates the design and implementation of the hydrographic geology assistant plot system according to the concrete condition of An – qing copper mine. System analysis shows that the hydrographic geology management and auxiliary mapping system can dynamic manage timely , accurate and effective for geological maps , and may provide a variety of information and charts accurately for the mine production and management decision – making at any time. (Lu Lan)

Study on the Engineering Application Class Courses Instance Analytic Pedagogy —In the paper , the author studies the engineering application class courses instance analytic pedagogy , analyzes its three explain stages for the question that students in engineering are difficult to transform book knowledge into the field application. The author analyzes the mining sufficient knowledge combining " Subsidence Engineering" course teaching practice. After-school feedback indicates that the method achieves good teaching results and can make students learn the ways of thinking how to use professional knowledge to solve practical problems. (Yan Yueguan et al.)