Research Article

A High Efficient Method of GIS Spatial Data Conversion

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Abstract: At present, most historical surveying data are stored with CAD format, so they can't be used directly in GIS. This paper focused researches the data format of the CAD and ArcGIS, introduces several methods of data conversion, points out the problems existing in data conversion, and achieves an efficient automatic conversion method from CAD data to Geodatabas database. This method has been applied to the actual project and received the good effect.
Keywords: AutoCAD; ArcGIS; Data Conversion.

INTRODUCTION

In recent years, ArcGIS with powerful spatial data handling capacity has widely applied in oilfield development, city planning, power pipeline and other industries. But most of the historical surveying data in these industries are stored in AutoCAD format, so they can't be used directly in GIS [1]. If these data are input again with ArcGIS format, it will take half of the workload in the whole project development, which will take a lot of time and energy. In this paper, according to actual requirement of oilfield geographic information system project, we need to convert mass CAD graphic data and stored them in the GIS spatial database. Through researching and analyzing the common used data conversion methods, we adopt the GP tool of ArcGIS to build application model and realize the automatic conversion from CAD data to the Geodatabase. Which has been well solved the complex operation, data loss and other problems exiting in the process of data conversion. This method has been applied to the actual project and received the good effect.

AutoCAD DATA AND ArcGIS DATA
AutoCAD data

AutoCAD is automatic computer aided design software which is produced by Autodesk company. The common CAD files includes line drawing file (.dwg) and design file (.dgn), it is mainly used for 2D drawing, detailed drawing, design document and the basic 3D design. It describes the spatial location and geometrical shape of geographic entity with linear, layer, color, font and so on [2-3]. But AutoCAD do not consider ground object's feature, hierarchy and topological relation for vector data management.

ArcGIS data

The basic meta-map element of ArcGIS includes point, line, polygon and annotation. The data storage format mainly includes Coverage, Shape file and Geodatabase. The Coverages is a vector file format, it is a gather of feature class which has been organized, every feature class is point, line, polygon or text. Geometry and spatial topological relation are stored in binary file, attribute data is stored in the table of INFO or RDBMS. Shapefile is a kind of spatial data open format, it can store the location and relevant attribute of geometric figure, but it can't store the topology information of geographic data. It is made up by graphic format(.shp) files, graphic index format(.shx) files, attribute data format(.dbf) files, projection format(.prj) files and so on. Geodatabase uses objected-relation database to store spatial data, which includes vector data, raster data, table and other GIS object. At the same time, Geodatabase can connect port of SQL Server database to operate and manage spatial data by ArcSDE.

The corresponding relation of figure element between Auto CAD and ArcGIS

The basic figure element of AutoCAD includes block, line and text. Block is a set of CAD figure element. Line is line entity composed of multipoint. The basic figure element of ArcGIS includes point, line, polygon and annotation. If the position of a element can be determined by a point, the element can be thought as a point. Line includes two point line, polyline, curve and so on. Polygon is a tightly closed area which may has hole or island. Annotation includes spatial position, font, rotation angle and other text information [4-5].

The corresponding relation of figure element between AutoCAD   and   ArcGIS   is   shown   in   Table   1.

Table 1: The corresponding relation of figure element between AutoCAD and ArcGIS

AutoCAD figure element	AutoCAD class	ArcGIS figure element	ArcGIS class
Block	Acdb Block Referance	Point/Line	IPoint
Single-line text	AcdbText	Point	IPoint
Multi-line text	AcdbMText	Multipoint	IMultiPoint
Straight line	AcdbLine	Line	ILine
Polyline	AcdbPolyline	Polyline	IPolyLine
Circle	AcdbCircle	Point Circle	ICireleaArc
Arc	AcdbArc	Three dot arc	IArc

THE METHOD OF DATA CONVERSION FROM AutoCAD TO ArcGIS

Before CAD data is used in related application of GIS, it must be organized and processed. Then we will introduce some mothods of data conversion from AutoCAD to ArcGIS.

The application of the third party software

By the third party software such as MAPGIS, ARCVIEW, FME and so on, CAD data can be converted into another data format which can be easily identified in ArcGis, then processing it in ArcGis. This method is relatively complex, and because of involving the third software, the data conversion process is not easy to be controled which may lead to data loss [6].

Export DATA method in ArcMap

In ARCMAP, CAD's file with DWG format is loaded, then was output into a Shapefile data or an empty Geodatabase feature class by EXPORT DATA command. Becasue CAD line drawing text of ARCMAP is shown as a mixture Coverage Anntation class, so the CAD text must be achieved through conversion function. The method is simple, but it needs to make the lines of CAD into closed polygon, otherwise it will result data loss.

Simple Data Loader method in ArcCatalog

In ArcCatalog, We choose a CAD data source which need to be imported, then use Simple Data Loader wizard tool to map CAD graphic attribute value to an existing database field. Before using the tool, the feature class of geographical database must exit in advance. If object feature is loaded in ArcMap and run on the versioned data at the same time, then the recently loaded data may not be visible.

CAD Client method in ArcSED

ArcSED CAD is the spatial data client of ArcSDE, it can be used for data conversion. It allows user to store, remove and edit data in AutoCAD or Microstation environment by ArcSDE. But the client only has read permission to access ArcSED for Coverages and Geodatabase [7-8].

### The data conversion method in ArcToolbox

ArcGIS provides a conversion tool to convert CAD data to Geodatabase. It defines a query to choose CAD object, creates a new feature class of Geodatabase as a part of conversation process, and then converts and stores the query result to the element class. In this way, in the time of exporting all CAD file with several graphical features, it will automatic build several corresponding feature class. CAD text will be converted into a Annotation feature class. The changing curve information, geometric feature and block property of CAD element will be saved in the process of converting.

REALIZATION PROCEED OF DATA CONVERSION FROM AutoCAD TO ArcGIS

Through comprehensive analyzing the advantages and disadvantages of several data conversion methods, we use the method specified in section 3.5. Using the Geo processing (GP) tool of ArcEngine to build application model to import the CAD file into Gedatabace, it realized the automatic conversion processing from CAD data to ArcGIS data.

Data conversion process

The data conversion process is shown in Fig.1
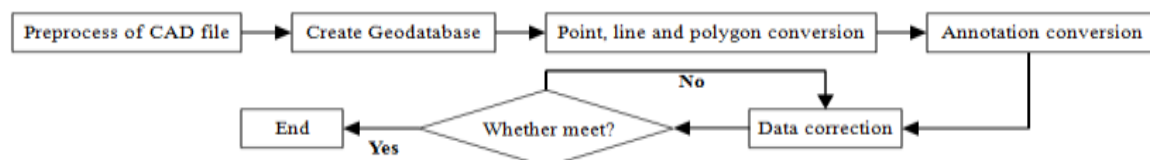
Fig. 1: Data conversion flowchart

Data conversion method

①Preprocess of CAD file: delete the content which need not be shown in ArcGIS, and change the name of layer and file in English.

②Create Geodatabase: create new Geodatabase in ArcCatalog, name CADTraSDE, set up the corresponding feature set and set the relevant

coordinate system. The projection coordinate is Beijing 1954.

③Point, line and polygon conversion: Here taking line conversion as an example. Selecting the Import->Feature Class(Single) command in right key menu on line element, an import dialog appeared as shown in Fig.2. Input Features is used to choose CAD line entity which need to be converted, Output Location is the feature name after converting, Output Featuer Class is the feature class after converting, Filed Map(optional) is the fields that need to be converted. After converting, the line element has three fields including Shape, Shape Length and OBJECTID as shown in Fig. 3. Among them, the Shape_Length is automatically generated line feature length after converting.

④Annotation conversion: open the ArcToolBox Window toolkit and choose Conversion Tool->To Geodatabase->Import CAD Annotation command. Input features is CAD text Annotation which will be converted, Output feature class is the path and filename for saving, Reference scale is the conversion ratio, and click OK button to start converting.

⑤Data correction: So far, the data conversion is complete. But it need to be corrected in ArcGIS. Open the map in ArcMap, find the current coordinates and accurate coordinates of more obvious markers on the map, and correcte it by adjustment spatial.
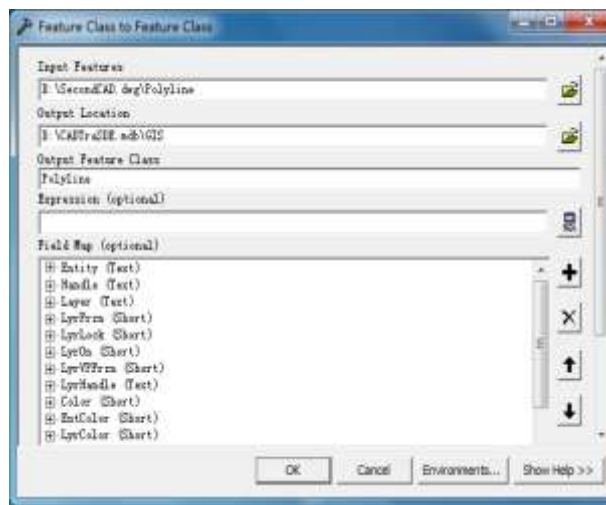

Fig. 2: Conversion dialog

Fig. 3: Line element structure

Map Load Program

In the program, the development component is ArcEngine 9.3 and ArcSDE 9.3, the development language is.NET (C#), and the background database is SQL Server 2008. The program code of loading map is as follows:

```
// load axMapcontrol map file
```

```
        string MapPath =
Application.StartupPath.ToString() +
@"\factory11.mxd";
        axMap.LoadMxFile(MapPath, 0,
Type.Missing);
        IPoint point = new PointClass();
        point.PutCoords(465403,5108526);
        axMap.MapScale = 5000;
        axMap.CenterAt(point);

        //load PageLayoutControl

axPageLayoutControl1.LoadMxFile(MapPath, "");
```

```
        //load hawkeye

axMapHawk.LoadMxFile(axMap.DocumentFilename,
null, null);
        axMapHawk.Extent = axMap.FullExtent;
        axMapHawk.Refresh();
```
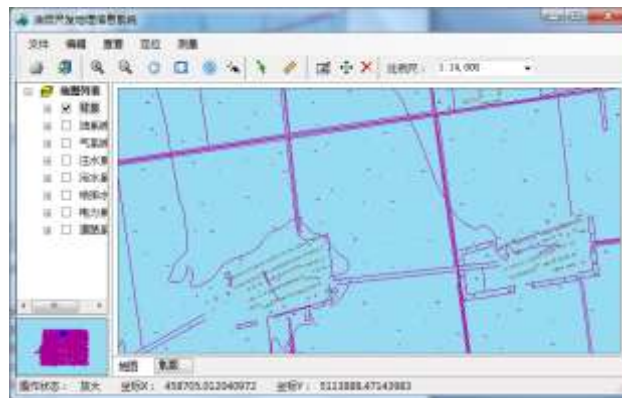
Data conversion instance

Taking the spatial data of oilfield ground management information system as an example, we displayed the actual conversion effect from AutoCAD to ArcGIS, the display scale is 1: 14000. Fig. 4 is AutoCAD graphical display before converting, Fig.5 is ArcGIS map display after converting.
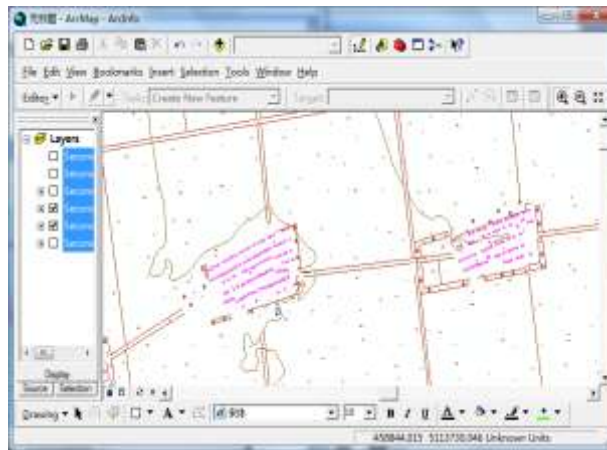
Fig. 4: AutoCAD graphical display before converting

Fig. 5: ArcGIS map display after converting

CONCLUSION

This paper researched the data conversion method from AutoCAD to ArcGIS, used GP tools of ArcEngine to build application model, and realized the data conversion from CAD to Geodatabase database. Then an actual conversion effect of oilfield ground management information system is given. The practice has proved that this method needs no much code and greatly reduce the workload of user. In addition, in the process of mass data conversion, it has fast converting speed, low data distortion rate and other advantages. It has certain reference value for actual production application.

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