

# Research on Computer Aided Design and GIS Conversion Method

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**ABSTRACT:** *It is an indispensable prerequisite for the establishment of geographic information database to convert all kinds of digital topographic map data to Geographical Information Systems (GIS) requirements. This paper introduces the significance and purpose of realizing the rapid conversion of CAD data to GIS data, and discusses the technical ideas of the conversion process. By using the computer-aided design data processing method, this paper has realized the computer-aided design data batch transformation and processing. It took the topographic diagram as the data pool to instance demonstrated and provided a feasible plan for the computer-aided design topographic diagram transformation which can maintain the data well the precision and the integrity.*

**Keywords:** Computer-aided design, GIS transformation, Topographic diagram transforms

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## 1. Introduction

In recent years, along with the development and more mutual of the Geographic Information System (GIS) technology, the foundation geography information data has applied thoroughly in every fields of the society. Especially when “the digital city” moved towards the popularization from the demonstration, the city foundation space data status is becoming more and more important, the form which is needed is getting more and more diverse and the data processing is becoming more and more diverse and complex. For instance, the transformation of data coordinates, the format conversion of data, the data extraction and so on [1]. In fact, the OGIS is a set of public space data manipulation function, which may apply in any platforms and systems, making it possible for the users to use in a sole environment and a work flow and being suitable for any geography data distributed on the net. At present, we have many methods for computer-aided design (CAD) and the GIS data conversion. For example, the literature [2] has studied the ways of the conversion form CAD to the GIS based on Geo-database, which has

the technical basis for the foundation topographic diagram database establishment. The literature [3] has constructed GML and DXF transformation plans based on the semantic mapping mechanism. According to these examples and through union use of the space Feature Manipulation Engine (FME) and Arc Map, this article has thoroughly discussed the realization process of CAD data convert to GIS data [4].

Computer Aided Design (CAD), refers to the concept of “combined with computer for solving group, a problem closely, play to their respective strengths, to make it work better than each party, and provides the possibility for a comprehensive multidisciplinary collaboration application method”. CAD is used by the engineering and technical personnel in systems and networks as a tool for the design of products and engineering design, drawing, analysis and preparation of technical documents, such as the design of the activities of the general [5].

Computer aided design includes a lot of content, such as: concept design, optimization design, finite element analysis, computer simulation, computer aided drawing, computer aided design process management, etc [6]. In engineering design, it includes two aspects: the creative design (the idea of the project, the work principle, and so on) and non-creative work, such as drawing, design, calculation, etc.,. A good computer aided design system has not only given full play to the creativity of people, but also make full use of the computer’s high-speed analysis and computing power, that is, to find the best combination of human and computer [7].

CAD technology abroad is the first major application in industrial product design, and its development has gone through 4 main stages: the preparation stages in 1950s; the initial stage in the early 60s; CAD commercialization stage at the end of 60s and 70s; and the rapid development of the 80s is CAD stage. CAD technology in China started in the last century in 60s, and after 1985 the development and research of large-scale CAD/CAM technology, the national unified planning, automobile, tractor, reducer, motor and other more than and 20 mechanical products for the development of CAD application system and CAD system have supported the product development. The development resulted in the launching of a number of software, including the mechanical parts design, the transmission system design, finite element analysis and optimization design method, CNC machining, system development tools module. During 90s, China’s CAD technology gained rapid momentum [8].

## 2. Comparative Analyses of DWG Data and GIS Data

In Geo database, a DWG document is corresponding one in a Geo database data set. While the DWG document has the same geometry information essential factors, which are assigned to the same essential factor classes, including the spots, the lines, the areas and the texts four essential factors classes [9]. There are some differences between the DWG format elements and the geometric information elements which are provided by the Geo database itself. In the conversion form DWG data to Geo database data, points, lines and areas, the three types of spatial data format are the same and the conversion process is relatively simple. While in the Geo database, the format of DWG data recorded information is coverage annotation with its geometry attribute is Point. The format of GIS note recorded information is feature class annotation, whose geometry property is Polygon; during note transitions, and paying attention to this problem is needed [10].

The application of open source components are the DWGDirectX read block reference (AcadBlockReference) basic information, including color, layer, linear, Xian Kuan, hyperlinks, geometric graphics information, including the location of X coordinates [11].

Position Y coordinates and position Z coordinates the X ratio, Y ratio, and Z ratio; other information, including the name of the block, and rotation angle. It will get the information saved to the elements class we created. In the future, we will sign the symbol in ArcGIS, and we will make it according to the symbol table [12].

The attribute data is stored in SQL Server2005 database, when converting CAD blocks reference, and according to the X and Y, the coordinates are retrieved from the database to record the attribute block reference, then the X and Y coordinate with the block reference saved to ArcGIS elements, so as to realize the conversion of the general elevation point [13].

The general elevation point is the block with attribute in the DXF file, it is in the form of INSERT and ATTRIB graphics primitives, ATTRIB part of the code 1 represents an attribute string height points, such as “1637.40”, the application of DWGDirectX component reads the block reference elevation point, must find a way to get the attribute information indicating the elevation, and then together with the INSERT X, Y coordinate primitive save to ArcGIS target elements [14].

### 3. Application Examples

#### 3.1 Data Analyses

A town in the 1:10 000 topographic map data format is for the CAD data format (.DWG). Before transformation, one needs to carry on inspection to further process the data chart by using the CASS software. It should delete the false points in the data charts and filter the non-attribute entity as well as to come the further inspection for data chart [15]. In addition, one must act according to the actual situation inspection data chart. For instance, the scale fence should not be closed; otherwise it will be regarded as the surface to process when it is inducted to Arc GIS, which will cause certain kinds of situations like covering the houses. Upon the completion of the inspection, the data can be used to preview and find out the attributes contained in each information layers. Use FME Universal and the Viewer in FME is loaded the topographic diagram.

#### 3.2 Data Conversions

Open the FME Workbench to find all CAD topographic diagram data needed to be transformed, and then build a folder to store the converted data. Click on OK and it will be able to establish the corresponding relations automatically. Then choose the level needed to be transferred. Click on OK Again, it will be able to establish the mapping relations automatically. Take 211 (general house) as an example, contents, including the points, the lines, the areas and the texts, have just discussed above. Therefore, it only needs to convert these data. It may delete other useless mapping relationships in Geometry Filter obliterate. And after preparation, click the start to transform and it will complete the switching process automatically.

For the sake of simplicity, the class name element layer name and GIS created in CAD is consistent in the GIS point data as INSERT CAD entity is the object insert. The coordinate data of point can be used as the output of the insertion point coordinate. The key is the conversion of symbols [16]. We need to establish a symbol table, ArcGIS data symbols have a special symbol library, but not CAD symbols, each CAD symbol is a separate DWG file, we can put the CAD symbols which are placed in a directory. When the symbol is converted, a CAD layer name is created based on the name of the GIS layer [17]. Each element then traverse the GIS elements, and we can render the symbols from the current map of the Feature Reader access to the GIS layer to use. Then the query point the symbol table, and access to the CAD requires the use of symbols (block) and GIS at the same time. According to the color of the point layer and the table, we can realize the conversion of other properties for GIS for example, the point symbol rotation angle corresponding to the attribute can also be set in CAD (See figure 1) [18].

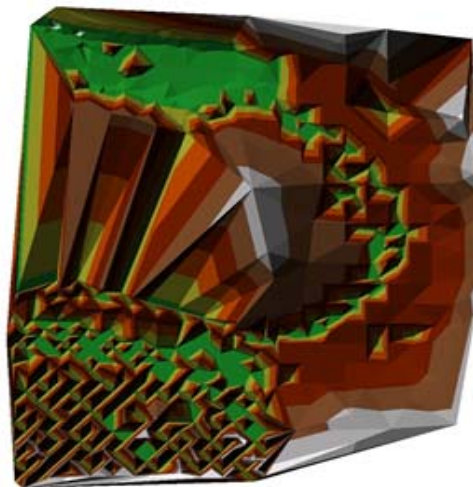


Figure 1. Conversion of CAD data to GIS data based on ArcGIS

### 4. Data Conversion Post-processing

#### 4.1 Topological Reconstruction

After the CAD data is converted into the GIS data, there may be some elements of deformation or data redundancy problems. In order to ensure the correctness of data, one must guarantee accuracy of objects, complete line elements connection, closed surface elements and some other topological rules. Repeat point, suspension point or pseudo node, etc. which often appear in

the point layer. If there are duplicate points, one can use of “delete” operation under the opening edition condition and set the appropriate symbolic style for the point elements. The connectivity problem appears frequently in the line layer. One may use the select operation to the same line of the same layer and transfer the (merge) method under the opening edition condition with the aim to achieve the integration of the line. The main task of polygon essential factor is to inspect the duplication of the public side and the closeness the polygon. As for the opposite chart level construction, one can inspect and revise it by using database topology rules. When it comes to make the multiple layers (point, line, surface) into one layer, one can use Append tool of Toolbox Arc toolbox to carry on the operation. Moreover, one may use Data management tools-Features-Feature to polygon to make the line plane of rotation operation and make other geometry type the transformation with the help of the tools of the Features tool collection.

#### **4.2 Bestows on the Attribute Value**

Although the CAD data does not have the attribute information, in the Arc, the GIS data attribute list is an important constituent of its data. For the consummation of data, after data format transformation, one can add new fields and entrust attribute values for the Geo database data or shape the file data with mutual operation. When the data quantity is large and the input attribute value may consume massive manpower, by using the Spatial the Join in the toolbox, one can make the attribute of a class of elements layer be associated to its related layer automatically according to the space position relations, realizing automatic batch supplement of attribute value and greatly enhancing the working efficiency enormously.

#### **4.3 Polygon Data Processing**

After the conversion of the data, the surface data appears in the measurement of control points, therefore one needs to analyze it according to actual situation: the first situation, after transformation, some layers both have point data and surface data which are distributed in the same position, one should remove the surface data according to the need; and the second situation, after the transformation, certain layers only have the surface data and do not have the points, one needs to make the data convert into the data points through Arc Map.

At the beginning, load the surface data, which needs to transform through software Arc Map. Then open Feature to the Point tool in toolbar Toolboxes to choose chart level which must transform, and choose position to save. Click on OK which can be able to realize the transformation. After that, the data can the auto-loading to Arc Map. All these can be helpful for inspecting the integrity and the accuracy of transformation. First, one can load the surface data which needs to be transformed through Arc Map, open Feature to Line tool in the toolbar Toolboxes, choose converted surface data chart level. After that one can choose the converted data storage location and click the OK to be able to realize the transformation. After the transformation, data can auto-load into Arc Map, so that the integrity and the accuracy of transformation can be well inspected.

### **5. Conclusions**

FME, which is powerful, has good versatility and feasibility in the GIS data cross platform transformation. It has the simple operation surface, which can use different operating modes to realize the identical kinds of data in the different platforms or ensured that different data can be shared in the identical platforms. It is gradually becoming the fact standard of every kinds of GIS software sharing data. This article unifies FME and Arc Map to carry on a union processing for the DWG form data, realizing the transformation from the CAD data to the ARCGIS data. The example proved that the method used in this article has realized fast loss less transformation for the spatial data. Besides, by transforming a surface data to point data or the line data and using the topological reconstruction and assignment processing for the transformed data, the later period database warehousing can be more convenient. Through the comparison of the final results, it can be seen that the consistency of the data before and after the conversion is of great significance for the realization of data conversion and is of certain reference value for the technical staff who are engaged in the development of geographic information system.

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