DXF FILE EXTRACTION AND FEATURE RECOGNITION

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Abstract—DXF file contains the information which cannot be read and understood by a normal user. This paper explains that how we can extract data from DXF file and convert it into a graphical format and tabular format. It also explains manufacturing feature recognition of a rotational component using DXF file. Feature recognition integrates two independent systems: CAD and CAPP.CAD files contain detail geometric information of a part. In this work geometric information of a rotational part is translated into manufacturing information through a DXF.A feature recognition algorithm is used to recognize different features of the part from its DXF file where geometric information of the part is stored after respective DXF codes. Finally, using the data extracted from DXF file, each feature of the part is recognized.

Keywords—CAD(Computer aided design), Feature Recognition, CAPP(Computer aided process planning), DXF(Drawing Exchange Format)

I. INTRODUCTION

All the CAD drawings are saved in a format which is called DXF format.DXF file includes all the information related with the diagram but the problem is DXF file is very hard to read. So to make it simpler we can develop an application that retrieves the important information from the file and will represent into tabular format and also in graphical format. In tabular all the information related with the object would be saved automatically. Suppose if we draw a circle so the dimensions like radius, area, perimeter, coordinates etc will be saved in a table, so anyone can see the details related with the object in case of graphical format. Suppose we upload a DXF file so it will create the object directly. Its like reverse engineering ,where we give data and it creates object. So this is a simplest way to read a DXF file. We can use this application in various fields like pattern matching also.

II. STRUCTURE OF DXF FILE

There are mainly six sections in DXF file[9].They are HEADER,CLASSES,BLOCKS,TABLES,OBJECT and ENTITIES. Each section contains some specific information related with the diagram. The ENTITY section plays a very important role in extracting the data as it contains the geometry definitions for all the items in DXF file drawing. Geometric information regarding each entity is stored after different DXF numbers or codes in the ENTITIES section. Here is given a line entity and circle entity example :

LINE The name of the entity
5
619
100
AcDbEntity
8 The layer marker
SECOND_LINK The layer name
100
AcDbLine
10 The 1st vertex's x coordinate marker
0.0 The 1st vertex's x coordinate value
20 The 1st vertex's y coordinate marker
0.0 The 1st vertex's y coordinate value
30 The 1st vertex's z coordinate marker
0.0 The 1st vertex's z coordinate value
11 The 2nd vertex's x coordinate marker

10.0	The 2nd vertex's x coordinate value
21	The 2nd vertex's y coordinate marker
10.0	The 2nd vertex's y coordinate value
31	The 2nd vertex's z coordinate marker
10.0	The 2nd vertex's z coordinate value
0	The end of the entity marker

CIRCLE	The name of the Entity
5	
202	
330	
AcDbEntity	
8	The layer marker
AcDbCircle	
10	X coordinate marker of radius
1000.0	X coordinate value of radius
20	Y coordinate marker of radius
1200.0	Y coordinate value of radius
30	Z coordinate marker of radius
0.0	Z coordinate value of radius
40	marker of radius value
400.0	value of radius
0	

III. DATA EXTRACTION FROM DXF FILE

As already mentioned in a DXF file data is stored in a single column. So a program is needed to extract the data from the DXF file. The program opens the DXF file and will search the 'ENTITIES' section line by line until a match is found because data regarding the part geometry is available in this section[2]. Lets suppose a part is drawn by a POLYLINE so when the program reaches the ENTITIES section it will search for polyline. After this it will search for the VERTEX and the x and y coordinates of it, following the DXF code 10 and 20.To know whether the line between two points are curved or not ,program will search for DXF code 42. DXF code 42 indicates that line between the current point and the next point is curved. Program will continue to do the same, until it reaches the 'ENDSEQ' which is the end of entity section. All the extracted data are saved in a file for as a reference for feature recognition.

IV. FEATURE EXTRACTION

A feature, in computer-aided design (CAD) software, can be called a region of a part with some interesting geometric or topological patterns[1].This meaning can refer to all sorts of information, such as for example, shape, functional or manufacturing information[2].Although many types of features have been investigated[3], the most common type of feature is the form feature, which contains both shape information and parametric information. Examples of form features common in many shape models are round holes, slots, bosses and pockets.

Often, product can be sophisticatedly designed with CAD, but then the designed results cannot be automatically passed to the manufacturing system. Manufacturing companies are learning that this lack of communication is a major obstacle to the achievement of the full benefits of CAD and CAM applications.

CAD is geometry based with, geometric entities such as 'line', 'arc', 'circle' and so on to represent the finished part. Down-stream in CAM, features such as 'face', 'taper', 'groove', 'chamfer' and associated attributes are common language[4].So the major challenge is to convert the CAD language into CAM. This requires a part feature recognition system.

Part data extracted from DXF file consists of coordinates of different points and have very little significance for manufacturing until different features and their attributes of the part are identified .Each line whether its straight or curved represent a special feature of the part. So to recognize its feature or part its necessary to get the information related with the point. Table 1 presents the logics used to determine different types of lines and their orientation[8].

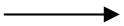
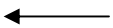
Logic	Direction	Line	D-type
if y1=y2 and x1<x2	Horizontal		1
if y1=y2 and x1>x2	Horizontal		2
if y1<y2 and x1=x2	vertical		4
if y1>y2 and x1=x2	vertical		8
if y1<y2 and x1<x2	Inclined		16
if y1>y2 and x1<x2	Inclined		32
if y1>y2 and x1>x2	Inclined		64
if y1<y2 and x1>x2	Inclined		128
DXF code 42 exists	Arc/curved		256

Table 1

A code D-type is assigned for each type of line as shown in table 2. Here (x1, y1) and (x2, y2) are two points that represent two ends of a line. As shown in the first row of table 2, if the value of X-coordinate of the first point is less than that of the second point and Y-coordinates of these two points are equal then the line connecting the two points is horizontal from left to right. So, the surface corresponding to that line is horizontal and parallel to the part axis. D-type of this line is assigned as 1. Similarly information regarding all other surfaces are determined and coded as shown in table 2. Curved surfaces are exceptional. DXF code 42 must be present after Z -coordinate of the first of the curve. When all the feature attributes are known, appropriate machining techniques like facing, turning, chamfering etc can be selected.

Foundation for feature recognition

A. Feature representation:

Boundary Representation (BRep) has emerged as the dominant solid representation scheme for most major CAD/CAM systems, and also for the input to feature recognition algorithms.

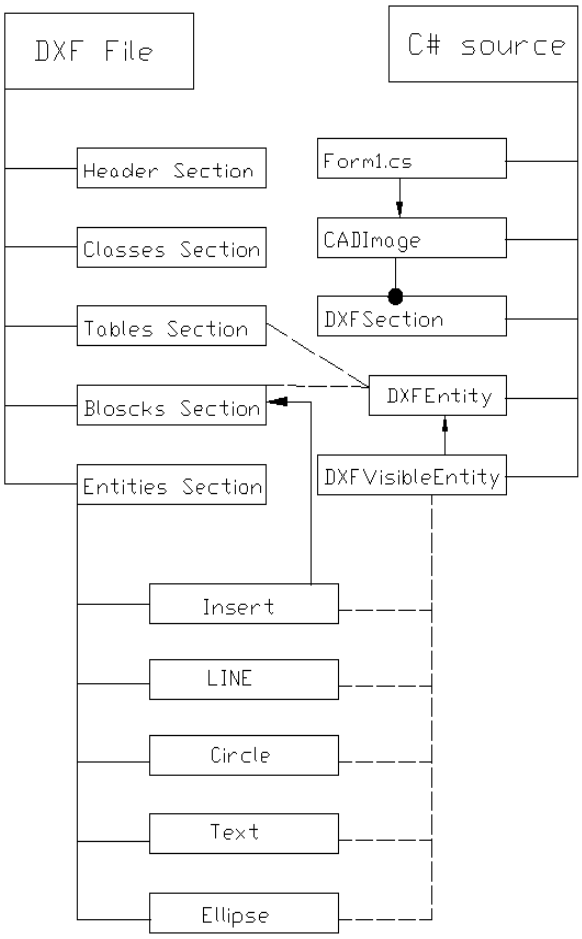
B. Feature classification and standardization:

There have been many efforts to classify machining features and devise feature hierarchies [5]. However, the feature community has not yet reached agreement on a canonical set of features for any application, and it is doubtful whether it is even worthwhile trying to achieve such a consensus. STEP (STandard for the Exchange of Product model data) provides a standardized means for the representation of product data for exchange between different CAD systems or sharing by different product life-cycle application programs.

C. Feature model generation:

A unique representation of a part in terms of features is often called a feature model or an interpretation of the part [6], [7].There are essentially two ways of creating a feature model: feature recognition and feature-based design.

V. DXF File and DXF Import .NET Structure



This scheme shows main parts of DXF file and the way they are connected with the C# source code in the project. The dash lines stand for associations between DXF file objects and objects, programmed in C#.CAD Image is a class for loading from DXF file and drawing to Graphics. It stores the DXF Entities in field.DXF Entity is base class for all Entities classes. Classes DXF Blocks and DXF Section are not visible. Class DXF Visible Entity is the ancestor for all visible Entities[9].

VI. CONCLUSION

In concurrent manufacturing systems, CAD and CAM plays the most important part for design and manufacturing. DXF file helps to provides the data. Data retrieval from DXF file is important in various aspects if we want to make the application user friendly. Data can be retrieved using C# classes. It make easy to develop the application. Extracted data helps to recognize the various parts of a manufacturing piece referred as feature recognition.

VII. REFERENCES

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