

Geometric Entities Information for Feature Extraction of Solid Model Based on DXF File

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Abstract

In recent years, various researchers have come up with different ways and means in identifying geometric entities for feature extraction. Automated extraction of features on determination a geometric entity of solid model becomes as one of the core tasks in CAD/CAM. In this research, we have adopted the latter approach by examining DXF format as the base of the 3D object. By using the DXF file, explained the structure of the file format that consists of six sections which are HEADER, CLASSES, BLOCKS, TABLES, OBJECT and ENTITIES. The structured of the proposed methodology consist of three main phase. First phase is exporting the CAD file to DXF code as an input to the second phase. The second phase, the code is classified to the categories it is belong to in facilitating the recognition of entities in geometry. Lastly, the third phase is maps the extracted features as it supposedly appear.

1. Introduction

Automated extraction of features on determination a geometric entities of solid model is one of the core tasks in CAD/CAM environment. Geometry is usually represented in the CAD system in terms of low level geometric entities such as vertices, edges and surfaces or in terms of solid entities like cubes, cylinders and etc. [8]. Features in geometry also can be described as groupings of topological entities from a component that are semantically significant in its production [5].

In this research, we have adopted the latter approach by examining Data Exchange File (DXF) format, which is one of the most popular file formats in CAD. In 1999, features extract for DXF file format has been used for 2D object, which was presented by B-rep, for rotational parts [4]. DXF file has been chosen by Aslan et.al for features extraction to introduce a form an integrated component of the expert system ASALUS for post-processing [2]. Nafis and Anwarul used this type of file format in recognizing parts of manufacturing feature [9].

This paper is divided into five sections. Section 2 discusses concerning about DXF file, the important and characteristic in DXF file. Section 3 presents the feature extraction of a basic feature. Section 4 shows the structure of the proposed methodology as a guide in developing new framework and conclusions are drawn in section 5.

2. Structure of DXF file

In Engineering file format, consists of few format such as IGES, STEP, DWG, MC8, DWT, DXF and etc. Every single type of file format has specification and being focuses here is DXF file format. DXF file format is being focuses as one of the most widely supported file format. DXF files are relatively easy to parse since they are tagged and text based and therefore human readable.

DXF was originally introduced in December 1982 as part of AutoCAD and was intended to provide an exact representation of the data in the AutoCAD native

file format. DXF files enable the interchange of drawings between AutoCAD and other programs. DXF files can be either ASCII or binary formats. Because of ASCII DXF files are more common than the binary format. Both ASCII and binary DXF files contain a complete description of the AutoCAD drawing. DXF file format provide an equivalent object type in other programs which creates a simpler geometric description of the drawing.

There are six sections in DXF file which are HEADER, CLASSES, BLOCKS, TABLES, OBJECT and ENTITIES. Among them, definition of object differs from ENTITIES where ENTITIES section contains geometric information regarding any object drawn in the design file [9]. This means part feature is extracted from the section [9].

2.1 Code classification

DXF code for basic entities (line and circle) is shown in figure 1 and figure 2 below. **0** indicates that a new section is started. **Section** refers to the name of the **entities**. In this case, name of the entities is **line**, **8** belong to group code and **0** is layer. **10**, **20** point to start point coordinates and **11**, **12** point to end point coordinate. Else, **1.0**, **2.0**, **3.0**, **4.0** is the coordinate of the start and end point. And for the circle, **100** mean the sub-level descriptor. **10**, **20**, **30** and **40** is the point coordinate where **10** refer to the center point of the circle and **40** is point to the radius (value after 40 is the radius). The ending of the section is identified **Endsec**.

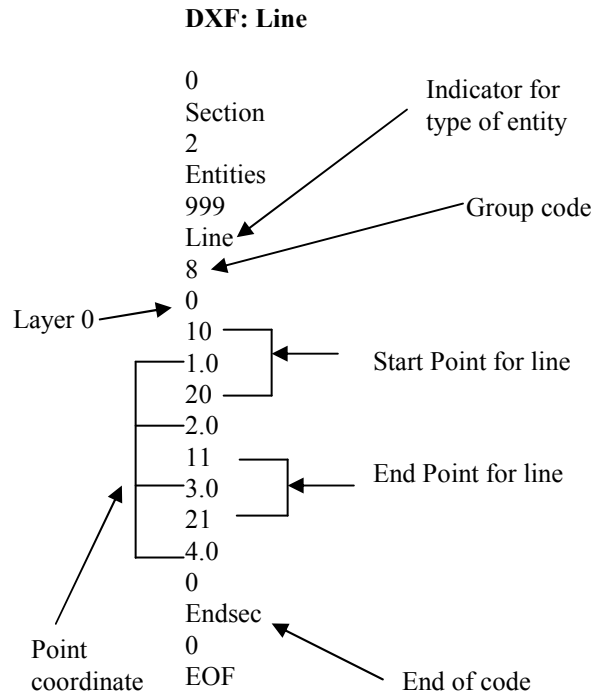


Figure 1

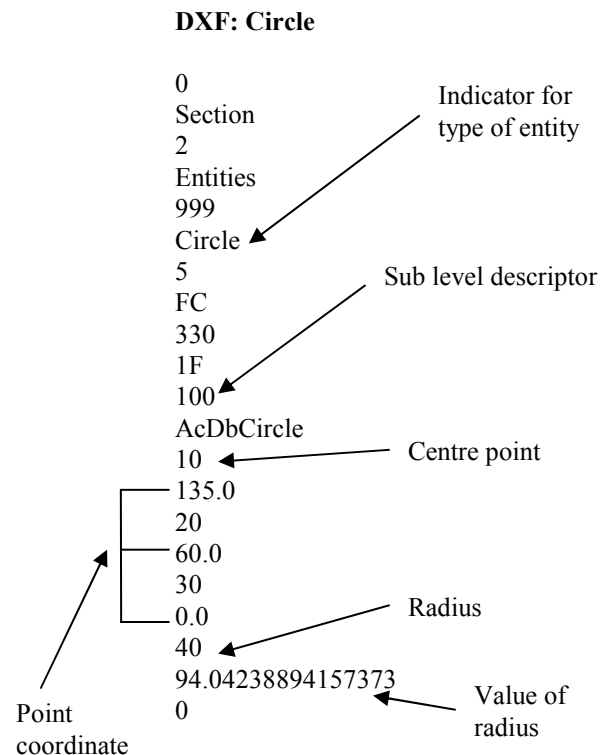


Figure 2

3. Features extraction

As stated by other researchers, the extracted feature data is analyzed respectively by face recognition [1]. Van Emmerik purposed that features can be classified into five categories that is from features, pattern features, connection features, property features and application features [10].

Feature was named by information entities were introduced to fulfill the need for high-level information that related to solid geometry model [6]. Explained by Shah and Rogers [5] in their works of Functional requirements and conceptual design of the Feature-Based Modelling System, feature was defined as set of information related to object description. The authors have classified features as follows:

- Form Features: Identify the combination of geometric and topological entities.
- Assembly features: location of parts for assembly
- Material features: specify material component and information

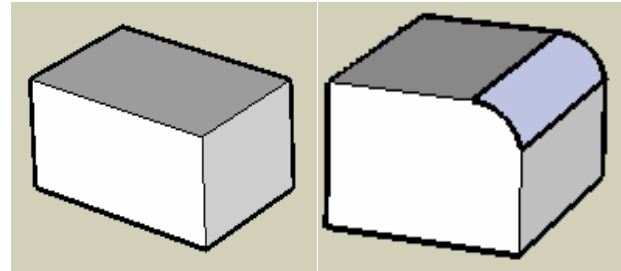
Jos et.al stated that features can be concluded as a collection of high level information defining a set of characteristics with a semantic meaning to a particular view in the life cycle [6]. The authors argue that the information contained in feature will accommodate the following aspects:

- Factual information: The information that specifies the actual characteristics that needs to be modeled.
- Descriptive information: Information that describe the contained in the factual information.
- Procedural information: Knowledge related to the feature. Obtaining the information contained in feature, validation of the information, dependencies, behavior and etc.

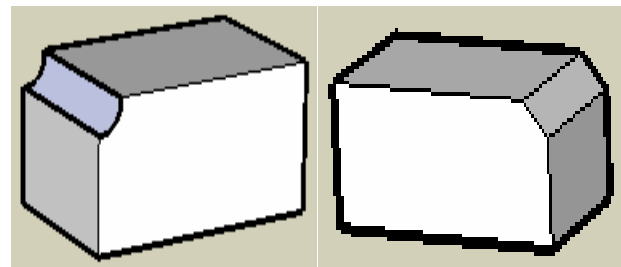
In this research, extraction on features is started with data extraction on DXF code where the classifying of code is done based on its declaration. Language of CAD geometry is based with geometric entities those are line, arc, circle and text. And for the manufacturing, the common language for geometric entities is known as face, chamfer, fillet and etc. Because of these, it becomes a major challenge in translating the DXF code to be recognized in manufacturing system and this requires a part feature extraction system.

The extraction of the feature consists in three main steps that explain in section 4. Basic features are

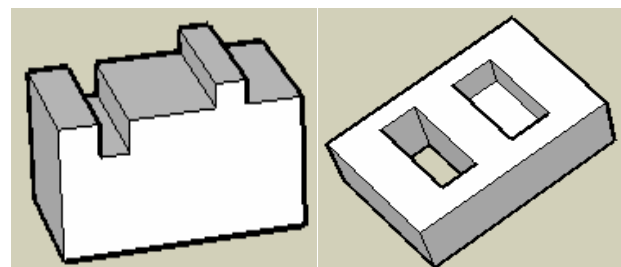
classified according to the modified geometric entities into elementary feature [7]. There are two types of modification features in solid which are edge/vertex modification and face modification that shows in figure 3 below:



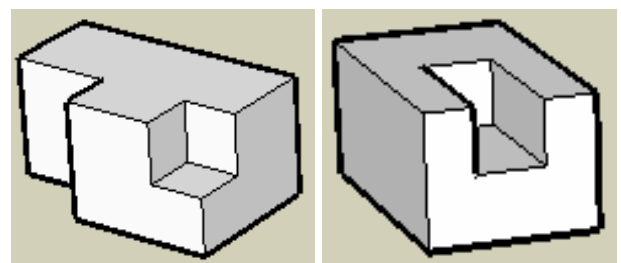
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- φιλλετ



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- Χουντερ φιλλετ - χηαμφερ
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Μοδιφιεδ φαχεσ Μοδιφιεδ φαχεσ
- Σλοτ - Ηολε
- Ριβ - Ποχκετ



Μοδιφιεδ φαχεσ Μοδιφιεδ φαχεσ

- Στεπ βλινδ
- Σλοτ βλινδ
- Στεπ

Figure 3

4. Structure of the proposed methodology

In this section, the structure of the proposed methodology is used as a guide in developing new framework and being used in system. The proposed structure in figure 4 is modified from Nasr and Kamrani [4] proposed method and combined from by Bustos et.al [3]. Classifying methods for 3D solid extraction process model focus on three different types of extraction which are volumetric, surface and image [3]. In this classification, the extraction of features in solid is regarded as a multistage process.

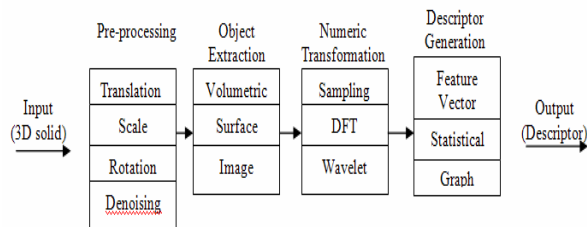


Figure 4

The new structured consists of three phases. The first phase export the sketch from CAD file to the propose file format (Data Exchange File (DXF)). The second phase, identify the code of the designed part into different features group. Lastly, the third phase maps the extracted features.

Phase 1: Exporting Sketch

Design drawn in CAD software and the software used is Sketch Up. Sketch up offered tools that can produce drawing as AutoCAD for 3D object. Sketch Up allowed user to design every single part of object as they imagine. Using this, few basic part designs is created as stated in figure 1 above. This design has been export to DXF using the same software. Exporting the design to this kind of code is one of the important steps because this code will be used for the classification in next phase. After designing and exporting, the code was used as an input in system.

Phase 2: Code Identifying

By receiving the input of DXF format for the design, the code is classified to identify the geometric entities (low level entities). The code is recognized line by line to classify which categories it is belong to in facilitating the recognition of entities in geometry. The identification of the geometric entities assists us in identifying the features of the 3D object. These 3D objects can be extracted using the identification of geometric entities to recognize the features.

In this phase, from the low level entities, intelligently translate the features extraction to the manufacturing information. Manufacturing information are listed and labeled once its been recognized. Besides that, by identifying the code of DXF file, the dimension of the 3D object can be known. The automatically dimension identification allowed the volume be calculated.

Phase 3: Maps the extracted features

Finally, when every single feature of the object are extracted and the manufacturing information are listed, the features maps again. As explained in phase 2, the DXF code will enter as input. This means the exact object cannot be seen. When the system runs, the final phase will attach the feature to the shape of the 3D object.

By comparing the result and the drawing in Sketch Up, proved wheather the system running as expected or not. If it is appear excatly as the original sketch, this means the code identification and classification is done smoothly. Figure 5 below show the structure of the proposed methodology.

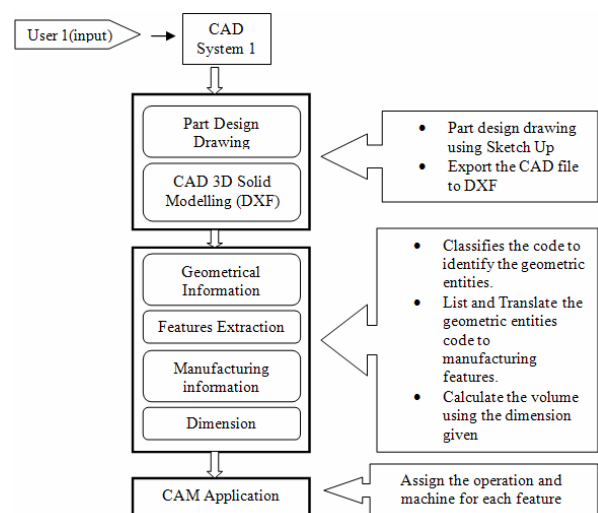


Figure 5

5. Conclusion

In this paper, a new modified and combined structure of methodology of extraction feature for geometric entities from DXF file format was introduced. As explained in structured of the proposed methodology, this new structured consists of three phases. The first phase export the sketch from CAD file to the propose file format (Data Exchange File (DXF)). The second phase, identify the code of the designed part into different features group. Lastly, the third phase maps the extracted features to process planning point of view.

This programme is run using Matlab where the geometric entities information needed will listed as its declaration on DXF code classification.

6. Acknowledgments

The authors are heartiestly appreciate Ministry of Science and Technology (MOSTE) for the E-Science grant and Research Management Center (RMC), University of Technology Malaysia (UTM) for the support in making this project a success.

7. References

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