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Research on Method of Integrating CAD and CAPP based on PDM

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***Abstract*—With the development of computer system , Computer-Aided Design (CAD)and Computer-Aided Process Planning (CAPP) have emerged as effective means of improving productivity and efficiency, resulting in widespread research work related to CAD and CAPP integration in the hope of achieving seamless data flow among the relevant computer systems. Unfortunately, the efficiency of process planning systems still needs significant improvement due to the problems of design data loss or design data misinterpretation. Combine geometric feature of 3-D CAD system with precision feature of CAPP system by the rules of renaming the feature tree in the CAD. Then interface module of CAD/CAPP is developed to extract the feature data from the model and store in the part feature table of the PDM. This method has not been confined to the special part and CAD system , and provide a kind of new thought for integrating of CAD and CAPP.**

Keywords- CAD/CAPP ; PDM ; Integration ;Feature Introduction

I. INTRODUCTION

Computer-Aided Design (CAD) and Computer-Aided Process Planning (CAPP) are classified as islands of automation and it is important that they can be linked together to achieve information exchange without taking into consideration the dissimilar formats being used by the various systems. In particular, CAD/CAPP is a key manufacturing technological development that can parallel design analysis, and therefore it can provide insight to manufacturing alternatives prior to committing to final decisions about the design of components or products [1].

Integration of CAD/CAPP is an inherent requirement of PDM, but there is still no perfect CAD/CAPP integration system. The main reason is that the technology of CAD and CAPP were developed independently, they can not exchange and transfer information each other automatically[2-4]. In this system, the integrated CAX interface based PDM is used to realize information share, the same database is used to avoid replicate data entries and transformation. Therefore the key techniques of CAD/CAPP integration is development of the interface. The CAD part models contain only simple Geometric Features, but the information needed by CAPP contain table title information and process feature information. The table title information contain the part numbers, material, hardness, heat treatment and so on, this kind of information can be processed easily. However, it's very difficult to extract and recognize process feature information needed by CAPP from the CAD system. In this system, the interface was developed by using Solid Edge Secondary Development technology, and the integration of CAD/CAPP based on the PDM platform was provided.

II. DEVELOPMENT OF CAD/CAPP INTEGRATION INTERFACE

A. Development Environment

Solid Edge Software provides several methods that enable to develop applications to extend Solid Edge functionality and integrate Solid Edge in second-development applications. Solid Edge Software Development Kit provides a set of interfaces and APIs that allow you to integrate Solid Edge functions into your own applications using Visual Basic.

In the VB developing environment, click "Project" pull-down menu, click "References"command, choose the Solid Edge library, then the properties, methods and events of the Solid Edge class can be consult in the object browser. The main library of Solid Edge are as follows:

Solid Edge constants Type Library: constants.tlb;
Solid Edge File Properties Object Library: Propauto.dll;
Solid Edge Assembly Type Library :assembly.tlb;
Solid Edge Part Type Library :assembly.tlb;
Solid Edge Draft Type Library :assembly.tlb;
Solid Edge Framework Type Library :assembly.tlb

B. The data structure of the feature

Today feature modeling was widely used in 3-D CAD system such as UG, Pro/E, Solidworks, Solid Edge etc, so the feature data in the CAD should be converted to the data of manufacture for the effective integration of CAD/CAPP. The part process information contain part name, part number, part feature, dimension, Dimension tolerance, form and positional tolerances, surface roughness, material, heat treatment, weight etc. In this paper, the feature data of CAPP structure was presented: part layer, feature layer, feature face layer and feature dimension layer. The relationship is: Each part was composed of lots of features, Each feature was composed of lots of feature faces. The data of part layer contain part ID, part edition ID, part name, part weight, material etc; The data of feature contain feature name, feature ID, feature type, ID under the part etc; The data of feature faces layer contain face ID, form tolerances, positional tolerances, surface roughness, hardness, ID under the feature, datum ID etc; The data of feature dimension contain feature dimension ID, dimension, dimension tolerance and ID under the feature etc. The data structure of the feature is shown in Figure 1-5.

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table of part layer
part ID
part edition ID
part name
part weight
material

Figure 1. The data structure of the part layer

table of feature layer
feature ID
feature name
feature type
ID under the part

Figure 2. The data structure of the feature layer

table of feature dimension
feature dimension ID
dimension
dimension tolerance
ID under the feature

Figure 3. The data structure of the feature dimension

table of feature face
face ID
form tolerance
positional tolerance
surface roughness
hardness
datum ID
ID under the feature

Figure 4. The data structure of the feature face

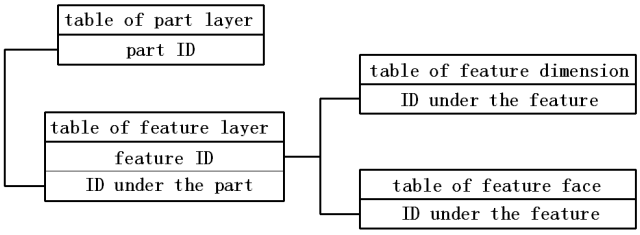

Figure 5. The connection of the feature data

C. *Name rules of the feature tree*

There are feature management in the 3-D CAD system based on feature modeling. The modeling stages and the main feature of the part can be recorded on the feature tree in the feature management. This paper takes a 3-D CAD software based on the modeling kernel of Parasolid - Solid Edge as an example to illustrate how to set the rules for the caption of the feature tree and realize the mapping extending between the geometric feature of CAD and process feature of the CAPP. The rules are as follow:

For each basic feature in the feature tree, the caption was named by the rules:

/ feature ID / name of the feature face / dimension tolerance / form tolerance / positional tolerance / surface roughness / hardness / ID of the datum feature

Each datum feature contains one or more feature faces, different feature face corresponds to different dimension tolerance, form tolerance, positional tolerance, surface roughness and hardness. The naming rules of Solid Edge feature Edge bar are as follow：

/ feature ID / name of the feature face 1 & name of the feature face 2… & name of the feature face n / dimension tolerance 1 & dimension tolerance 2 … & dimension tolerance n&/ form tolerance 1& form tolerance 2…& form tolerance n&/ positional tolerance 1& positional tolerance 2 …& positional tolerance n&/ surface roughness 1& surface roughness 2 … & surface roughness n&/ hardness 1& hardness 2…& hardness n&/ ID of the datum feature

D. *Algorithm of process feature*

By means of doing research work in the programming interfaces of Solid Edge and the structure of part and feature, this paper puts forward the methods for the access path of feature: Application → Documents → Part Document → Models→Model→Feature→Property（Profiles→Profile→Property）. The structure of dimension object and feature object are shown in figure 6 and figure 7.

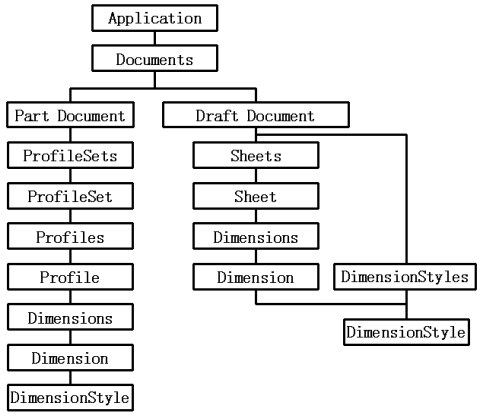

Figure 6. The structure of dimension object

The feature information can be extract from the CAD system by using feature and dimension programming

technology. With the second development of 3-D CAD software based on feature, the information of part layer, the basic feature data, information of feature face and information of feature dimension were extract, and then were stored in the PDMS （Product Data Management System）in order to build global product information model and provide full product data.

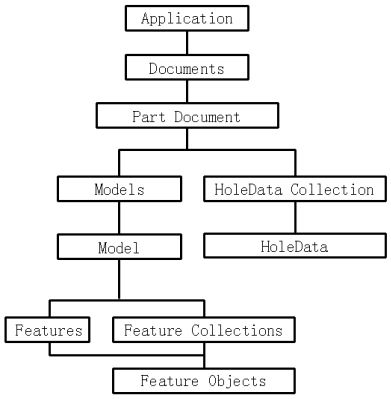

Figure 7. The structure of feature object

The information of part layer can be management by PDMS (Product Data Management System).

Acquisition of feature information: Traverse every basic feature object in the feature tree by using interface function of Solid Edge, and then get the name caption to acquire the feature face caption (tolerance, surface roughness).

Acquisition of feature face layer information: Decompose the Name caption by using the Split function, to get every name and data of feature face.

Acquisition of feature dimension layer information: Acquire the feature dimension while traversing the feature. For the “Cutout” and “Protruction” feature, the path to feature profile dimension is “profile”->“diameter” (“length”), the path to feature depth is “profile”->“depth”.

III. THE SYSTEM INTEGRATION OF CAD/CAPP BASED ON PDM

PDM is an information infrastructure that facilitates the collection, saving, and management of a variety of product data in the life cycle of a product. The data ranges from conceptual definitions of products to details of the design, development, manufacture, and delivery of products, as well as customer service[5].

PDM is an integrated platform of CAD (Computer Aided Design)/CAPP (Computer Aided Process Planning)/CAM (computer Aided Manufacture), also a frame for information integration of an enterprise. It is an important foundation for building the overall information model of manufacturing of engineering product [6-8].

The integration of CAD and CAPP system based on the PDM platform was provided in this paper. Taking the product structure tree as data structure, all product information can be managed as a whole in Product Data Manage (PDM).The product structure management module of PDM system oriented to small and medium-size enterprises is shown in Figure 8.

The feature tree must conform with the rules so as to extract the feature data. For example, click a part(flange) in the product structure tree, the information of the part will show in the data grid, and the part model will show in the 3-D browser .Click the button“ Add CAPP Data ”， the CAD software will be open, as shown in Figure 9. On the top right hand of the Figure 9, there are part feature tree. Each basis feature was recorded with the rules, so as to meet the requirements of CAPP. The feature data can be stored in the part feature table through this interface to realize the data sharing and seamless connection.

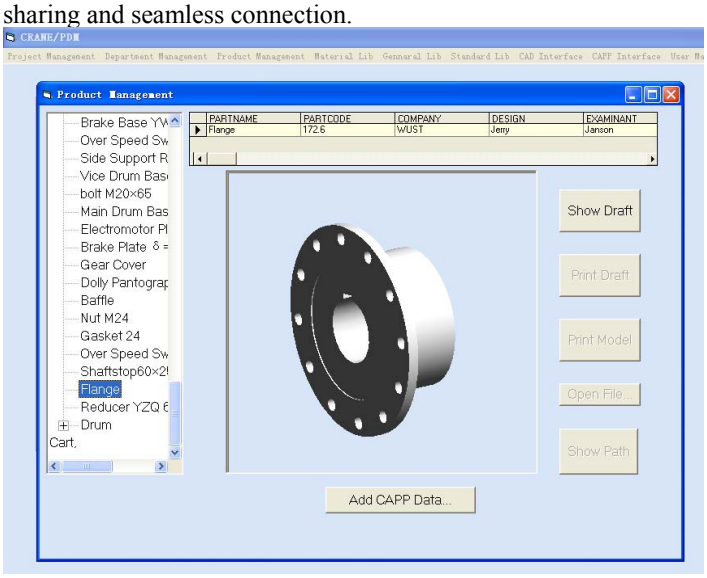

Figure 8. The module of the product structure management

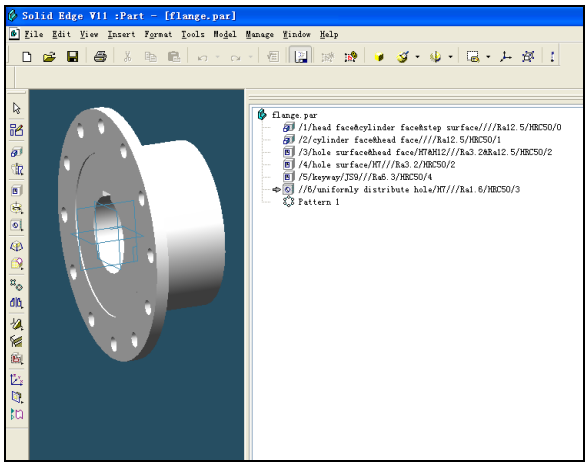

Figure 9. The module of the feature data management

IV. CONCLUSIONS

This paper provides a method of integration for CAD/CAPP based on PDM system. The CAPP information was divided four layers according geometric feature data in CAD system and the rules of feature tree are presented. The four layers feature information were extracted, and stored in part feature tables. The CAD-CAPP interface was developed for data transmission and information sharing. The method can be used in other 3-D CAD system.

REFERENCES

[1] H.C.W. Lau , C.K.M. Lee et al.(2005) Development of a computer-integrated system to support CAD to CAPP. Int J Adv Manuf Technol 26: 1032–1042.

[2] Yang Yujun ,Zhang Jinsong et al.(2006) Internet-based collaborative product development chain for networked product development. Int J Adv Manuf Technol 28: 845–853.

[3] M.Y. Huang ,Y.J. Lin et al.(2004) A framework for web-based product data management using J2EE. Int J Adv Manuf Technol 24: 847–852.

[4] C. S. Sung , Sam Joon Park (2007) A component-based product data management system. Int J Adv Manuf Technol 33: 614–626.

[5] Jeongsam Yang & Soonhung Ha et al. (2009) OpenPDM-based product data exchange among heterogeneous PDM systems in a distributed environment 40:1033–1043.

[6] Chiara E. Catalano ,Elena Camossi et al.(2009) A product design ontology for enhancing shape processing in design workflows. J Intell Manuf 20:553–567.

[7] Niko Ville Salonen (2007) Dynamic product structure configuration of superimposed part structure solutions. Int J Interact Des Manuf 1:185–194.

[8] Jeongsam Yang ,Soonhung Han et al. OpenPDM-based product data exchange among heterogeneous PDM systems in a distributed environment. Int J Adv Manuf Technol 40:1033–1043.