RECOGNITION OF ISOLATED PRISMATIC FEATURES FROM FEATURE BASED MODEL

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This thesis is dedicated to

my beloved parents, ***Raphael Yap & Cecilia Lai,***

my supportive brothers, ***Erwin, Terence, Adrian and their spouses***

and my special and faithful companion, ***Vivian Jong Shzu Shian***

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ABSTRACT

The objective of this study is to develop a feature recognition algorithm to convert geometrical and topological data of a feature from Computer Aided Design (CAD) system to an identifiable manufacturing feature that can be used in Computer Aided Manufacturing (CAM) system. An algorithm was developed by using Visual Basic for Application (VBA) as the programming language and Application Programming Interface (API) as the interface to interact with the CAD program. The features to be recognized by this algorithm are isolated prismatic pocket namely square slot, square step, square notch and square open pocket. The algorithm was also able to recognize non-orthogonal features as well as the dimension of the blank workpiece needed to machine the design. The algorithm utilizes the connection of the vertices in a design to determine the type of machining feature on the design as well as the location of the feature in form of coordinates. The evaluation of the algorithm shows significant improvement in recognition time compared to pattern matching algorithm.

ABSTRAK

Tujuan kajian ini adalah untuk mengembangkan algoritma pengenalan ciri-ciri untuk menukarkan data geometri dan topologi dari ciri-ciri dalam Computer Aided Design (CAD) kepada ciri-ciri pembuatan yang boleh digunakan dalam Computer Aided Manufacturing (CAM). Satu algoritma telah ditulis dengan menggunakan Visual Basic for Application (VBA) sebagai bahasa pengaturcaraan dan Application Programming Interface (API) sebagai antara muka untuk berinteraksi dengan program CAD. Ciri-ciri yang akan diakui oleh algoritma ini adalah ciri terpencil prismatik iaitu slot bersegi empat, langkah bersegi empat, takik bersegi empat dan saku terbuka bersegi empat. Algoritma ini juga mampu mengenali ciri-ciri non-ortogonal serta dimensi workpiece yang diperlukan untuk memesinken desain. Algoritma ini menggunakan sambungan vertex dalam desain untuk menentukan jenis ciri-ciri pemesinan pada desain serta lokasi ciri-ciri dalam bentuk koordinat. Evaluasi algoritma menunjukkan peningkatan yang menberansangkan dalam waktu pengenalan dibandingkan dengan algoritma pencocokan pola.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

Process planning is an integral part of design and manufacturing process that coverts design data into the process sequences and instructions to efficiently and effectively manufactured products. As the design and manufacturing process is supported by many computer-aided tools, process planning has also taken the path to utilize computer intelligence and drastically evolved to simplify and improve conventional process planning method to achieve more effective use of manufacturing resources.

Computer Aided Process Planning or more commonly known as CAPP is a bridge between the integration of Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM). In CAPP, manufacturing related features play a key role to initiate and facilitate the activity of determining the routings, process plan and fabrication as well as assembly drawings. The routings, which specify operations, operation sequences, work centers, standards, tooling and fixtures, is a critical input for manufacturing resource planning system that define operations for production activity control purposes and define essential resources for capacity requirements planning purposes. On the other hand, process plans generated by CAPP provide more detailed, step-by-step work instructions including dimensions related to individual operations, machining parameters, set-up instructions, and quality assurance checkpoints.

In order to obtain manufacturing related information from CAD data to be used in CAM system, features should be recognized. CAD is responsible for assisting engineers to design parts and create the geometrical database to be manufactured. However, the part description which is in the form of topological and geometrical is unusable directly in process planning because the description is not in the form of feature. Therefore these parts need to be translated into engineering specification of the finished part which then can be applied into process planning. There had been three decades of feature recognition researches that had been done since the seminar work of Kyprianou in 1980 and the literature work on feature recognition up to now is large (Han, J.H., 2000).

This report will attempt to review the most common or active feature recognition method in this field and in the process, develop a new algorithm to recognize some specific features chosen for this study. The proposed algorithm or methodology will then be tested and the results evaluated to measure the efficiency and effectiveness of the proposed approach. As the first stage of this research, this report will be divided in three main sections as follows. The first chapter will clarify the problem of the study and state the objectives, scope and also the significance of this study. The second section will review the concepts and terminology of feature recognition in detail as well as some of the literatures done by previous researchers in this field. The third section will explain the proposed approach developed in detail and the methodology used to perform the proposed feature recognition technique. The methodology should be done thoroughly and carefully in detail because it will be the most critical section and is considered as the main framework of this research that will determine the steps to be taken in the following stage. After the algorithm were developed, the the efficiency and effectiveness of the approach will be evaluated then follow by the discussions and finally, the conclusion of the overall research.

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1.2 Statement of Problem

Despite the various and voluminous literature and researches done by previous researcher, there are no universal algorithm in feature recognition techniques that can effectively and efficiently identify any kind of feature a part has to offer. Some techniques might be effective to recognize simple features while face difficulties in recognizing interacting features and vice versa. Features of manufactured products had also evolved to be more and more complex. Therefore, more advanced feature recognition techniques or algorithm will be required to cope with these features. Although there are various techniques available in this field, there are still other potential methods that can be explored in the quest of a more efficient and effective and if possible, a universal feature recognition technique. Only by constantly developing new ideas for this feature recognition technique can new platforms be established in pursuit of perfect feature recognition method.

Time is the most important essence throughout the entire production system because it will ultimately affect the costs and profits of the organization and feature recognition process is also not excluded. Hence, to develop a feature recognition algorithm, efficiency and effectiveness should always be kept in mind of the developer. Effectiveness will ensure the various features of the part to be recognized successfully while efficiency will enable the features to be recognized at minimum time. If a feature recognition algorithm is able to incorporate both these attributes into the process, its positive impact on overall production process will be substantial to the organizations and no doubt, to the entire manufacturing industry. Therefore, this project will attempt to develop a feature recognition system that is both effective and efficient by focusing on isolated features by translating low level data in B-Rep models in SolidWorks software into useful machining information usable for CAPP.

1.3 Objective

To develop a system based algorithm structured by using VBA programming of SolidWork solid modeler using API to achieve the recognition of isolated features from model which has been created on feature based modeling in the form of 3-D.

1.4 Scope of Study

The topological and geometrical data are retrieved from a feature based model. An algorithm will be developed to recognize isolated features detected on the model and a feature recognition system will be created based on the algorithm developed.

The facilities used to conduct this research are as follow:

i) SolidWork 2007 as solid modeller;
ii) Application Programming Interface (API) to implement the algorithm;
iii) Visual Basic for Application (VBA) as programming language;
iv) Microsoft Windows XP Professional Edition SP2 operating system
v) X86 Family 15 Model 107 Stepping 1 AuthenticAMD ~2108 Mhz processor
vi) Total physical memory of 2GB.

The isolated machining features to be focused in this research are as follow:

i) Notch
ii) Step
iii) Open pocket
iv) Slot

1.5 Significance of Study

The outcome of this research will be able to:

i) Provide an alternative preprocessor in CAPP system to convert CAD data into machining feature for manufacturing purposes.

ii) Provide another platform for feature recognition technique for future researches.

iii) Provide substantial time reduction in feature recognition process.

iv) Provide effective and efficient feature recognition system that can be applied to the manufacturing industry.