RDBMS – BASED COMPUTER AIDED PROCESS PLANNING

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Abstract

The process planning is the task that links the design information into the manufacturing processes and determines the operation sequence in manufacturing. Process planning is concerned with the preparation of route sheets that list the sequence of operations and work centers require to produce the product and its components. In the area of process planning, there could be manufacturing, assembly and inspection processes. Computer-aided process planning can be a solution that provides a great assistance in this aspect and could even replace the human planners in the planning procedure. A CAPP system can not only increase the consistency of process plans but also their correctness. Yet, such kind of systems should be developed with sufficient learning capabilities and human thinking logic. The main scope of the study is the efficient computer aided process planning to overcome the problem of complexity in CAD/CAM systems by developing Relational Database CAPP

Keywords: CAD/CAM, Database, CAPP, STEP

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1.Introduction

Process planning is a function within a manufacturing facility that establishes which processes and parameters are to be used to convert a part from its initial form to a final form predetermined in an engineering drawing. In manufacturing, process planning is the task that transforms the design information into the manufacturing processes and determines the operation sequence.

Process planning is concerned with the preparation of route sheets that list the sequence of operations and work centers require to produce the product and its components. In the area of process planning, there could be manufacturing, assembly and/or inspection processes. With the introduction of computers in design and manufacturing, the process planning part needed to be automated .

Manufacturing firms try to automate the task of process planning using CAPP (Computer Aided Process Planning) systems due to many limitations of manual process planning. Computer-aided process planning can reduce some of the decision making required a process planning. It can reduce the skill required of a planner, process planning time, both process-planning and manufacturing cost, it can create more consistent, more accurate plans for increasing the productivity.

2.Review

In recent years many researchers have come up with different ways to integrate CAD with CAM. Computer Aided Process Planning provides an important digital link between CAD model and manufacturing instructions. The CAPP system is developed while the manufacturing method is being determined, and is used and revised throughout the life of the production system. CAPP includes the hardware systems involved in the process, the personnel operating these hardware systems, and data stored about current and past production. Some CAPP systems automate the manufacturing process by making real-time decisions based on the model of the part, sensors in the assembly hardware, or other sources. There are so many research works related to CAPP and optimizing CAPP were done before.

Although there exists a large number of CAPP systems in the literature, however, a very few of them have intended to provide globally-optimized operation sequences. To determine the optimal sequence, various classical techniques like branch and bound methods, linear programming, dynamics programming have been discussed in detail by Lin and Wang [1] , and Koulamas[2] . As the operations sequencing problem involves various interdependent constraints, it is very difficult to formulate and solve this problem using classical techniques alone. Recently, most works applied met heuristics for solving process planning problems. Bhaskara Reddy et al.[3] applied genetic algorithms to generate the optimal sequence of manufacturing operations. The feasible sequences are generated from the feature precedence

relationship based on the precedence and geometrical tolerance constraints. Li et al.[4] developed an algorithm based on genetic algorithm (GA) to find the optimal solution. Based on their studies, they have concluded that the approach was more realistic and possible to find a global optimal process plan. Foerster et al.[5] used simulated annealing for order spread minimization in sequencing cutting patterns which is classified as Non-deterministic Polynomial (NP)-complete problem and it can be considered as a generalized Travelling- Salesman Problem (TSP). Li et al.[6] investigated the application of constrained-based search approach for optimization of process plans. Further, it was investigated by Krishna et al. using ant colony algorithm and found that the computational time has considerably reduced. Guo et al.[7] applied particle swarm optimization for operation sequencing problem and concluded that there is still potential for further improvement in computation efficiency and optimality if introducing new operators and characteristics of other algorithms. Furthermore, Mojtaba et al.[8] again applied genetic algorithms to generate the optimal sequence of manufacturing operations in preliminary and detailed planning. Among these heuristic methods, genetic algorithms and simulated annealing represent powerful combinatorial optimization methods with complementary

3.The structure of CAD/CAM integrated system

The popularization of computer network environment and thorough research and development of concurrent engineering provide technical base for realizing distributed collaborative product development.

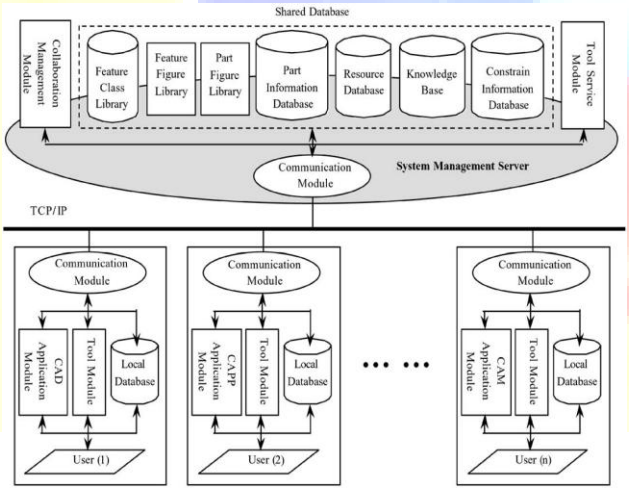

Fig. 1. CAD/CAM Integrated system

In collaborative development environment, various engineers concurrently and collaboratively participate in whole course of the same product development including design, process planning, manufacturing, assembly and so on. So CAD/CAM integration is not just simple combination of various applications, but should make information and data process in whole system have sufficient timeliness,

accuracy, consistency and sharing. Based on this, we constructed a CAD/CAPP/CAM integrated system that is supported by Internet/Intranet network and TCP/IP protocol and based on database to support collaborative development. This system integrates some application subsystems including feature-based CAD subsystem, CAPP subsystem, CAM subsystem and so on and some tool service subsystems including constrain management subsystem, evaluation and decision supported subsystem, database management subsystem and so on.

A user can plan a manufacturing process after defining the manufacturing features of the 3D model. Four modules, including part fact, operation selection, machine selection, and tools selection modules, as illustrated in Fig. 3, describes an algorithm for planning manufacturing process. The part fact module is used to obtain the required information concerning machined shape and the tolerance for process planning.

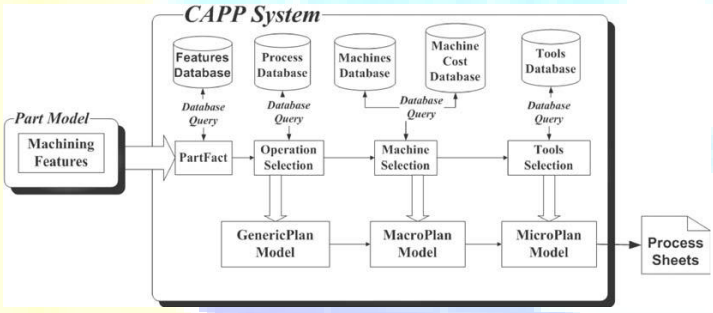

Fig.2. Algorithms of manufacturing process planning used in the proposed system

The operation selection module is used to access feature classification and machining properties, support classification, and determine the sequence required by the specific tolerance and surface area. The machine selection module accepts the information from the two modules before it calculates a suitable machine whose cost is relatively low. The tools model, similar with machine selection module, calculates the suitable tool whose cost is relatively the least and result of process planning is stored in the to database to be accessed by clients.

4. The Structure of CAD/CAPP Integration Systems

Integration of CA systems isn´t just that systems can communicate together, they must understand together too, that is they must share date that often are saving in different types of models with different information's format. It depends at systems that must by integrated together. If it's CA systems with similar character (for example CAD systems), then their communication mainly depend at supported by transfer of protocols DXF, IGES, SAT, SET, VGA, VRML, STEP, DWG etc. The integration of CA system with different character their function is complicated. The integration of CAD of CAD/CAM system with CAPP system is most complicated. It's mean making integration of every systems which are

intended for construction added design (CAD) and systems intended for computer aided process planning (CAPP). This two engineering activities are very related together and interlock. It‘s necessary to transfer geometrical (design and dimensions) and non geometrical (material, tolerances, buckling etc.) information between this two systems. This information affects in large area planning of technology of production. There are the reasons of troubles of data integration in different computer systems. The problem exist by the transformation of different data models and often in ambiguity of data structures too. Without this mentioned data it‘s impossible to crate technological documentation as output CAPP system.

5.Application programming interface (API)

An application programming interface (API) is a library of functions in a particular programming language which are available in a particular software program and they play a critical role in CAPP. They provide a direct access to design and manufacturing data residing in CAD/CAM databases and have tools to customize user interactions and automate graphical user interface functionality. As mechanical designers and manufacturing engineers define product specifications and make process planning decisions, the resulting information, including material requirements, setups, machining times and tooling become available for processing in real time. CAD/CAM systems use Visual Basic (VB), C, FORTRAN, Java, LISP or a proprietary language to access API functions. Advances in the tools provided by these languages and better CAD/CAM database structures present opportunities to automate many repetitive tasks and retrieve design and manufacturing data.

6.Neutral Format STEP

Transmission problem with no geometric entry promote solve neutral format STEP. This format solves interpretation and exchange entry of production model with ample quantity of information that we need for upgrading connection application software with straight valuation and with minimal interaction human. Production model is assumption of information power for purposes generate job description for production, straight test of quality and for execution production subsidiary functions. Seldom hold a production entry element how for example is technical conditions modification material. In addition was formation vision, that standard will be support full measure no geometric entry’s how for example are: scale tolerance, material property and face rough. Geometric model includes planes presentation for frontier and construction form plain geometry. This connection with no geometric entry and with relative information’s come out from idea, that transmission system will be use standard to formation complete production model. When we compare format STEP for example with format IGES, so format STEP have a fortiori information’s, that are needs and important in production process component. From this and same from table resulting that from this aspect description production entry is this format (STEP) most effective. As for needs production technological documentation are needs complex data about component

equally geometric as well as no geometric nature. For integration CAD and CAPP systems is format STEP as best instrument for they're intermitting.

7.Proposed Approach

In the conventional Computer aided process planning the data flow rate is very low because the system has to refer each and every design data and then verify it then given to the machining unit. This is very much needed and will take long time for getting accuracy in the product. The Relational Database Computer Aided Process Planning eliminates problems generally occurs in the data identification and accessing because of its following unique features.

A. Multiple user interface

RDBMS allow multiple database users to access a database simultaneously. Built-in locking and transactions management functionality allow users to access data as it is being changed, prevents collisions between two users updating the data, and keeps users from accessing partially updated records.CAD/CAM systems deals with large amount of design parameters which should be stored in the database and these details are referred and updated if any modifications done on the basic design.

B. Backup and Recovery

Backup and Recovery is the one of the most important aspects of database administration. If a database is crashed and there is no way to recover it, a business could face devastating results, including lost data, lost revenue and customer dissatisfaction. Companies operating single or multiple databases, storing hundreds of gigabytes or terabytes of data, all share one common factor the need for a plan to backup important data and protect themselves from disaster. The main focus of the backup and Recovery are the following.

1. Protect the database from failure wherever possible
2. Increase the Mean Time Between Failures (MTBF)
3. Protect by redundancy
4. Decrease the Mean Time To Recover (MTTR)
5. Minimize the loss of data

C. Restricted Access

All information in a relational database including table names and column names are represented by values in tables. User productivity is improved since knowledge of only one language is necessary to

access all data such as description of the table and attribute definitions, integrity constraints. Access to data can be restricted.

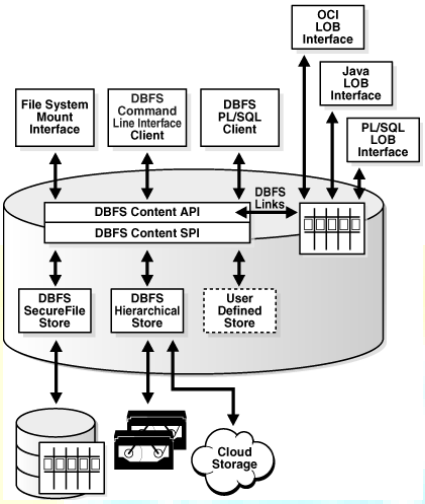

Fig. 3. Oracle Database File System (DBFS)

D. Controlled Redundancy

Data redundancy can lead to inconsistency in database unless controlled. RDBMS system is always aware of any duplication. The system is responsible for ensuring updates are carried out correctly. CAD information will be transferred to CAM contains lots of similar data in which duplication will be eliminated.

E. Integrity Constraints

Integrity constraints are used to ensure accuracy and consistency of data in RDBMS systems

A RDBMS provides various functions like data security, data integrity, data sharing, data concurrence, data independence, data recovery etc. However, all database management systems that are now available in the market like Sybase, Oracle, and MS-Access do not provide the same set of functions, though all are meant for data management.

6.Conclusion

The RDBMS-based CAPP proposed in this study implements the STEP AP224 data model to bridge CAD and CAM systems and thereby maintain the relationships among product, shape and feature definitions. The product-oriented data model defined in STEP can ensure the exchange, sharing, and integration of data with other engineering information systems. The proposed feature recognition approach enables the CAPP system to be integrated and distributed. The proposed CAPP system shortens the life cycle of the product from design to sale, and especially reduces the period of manufacturing. The cost of manufacturing is reduced, and the quality of the product can be improved.

The efficient computer aided process planning implemented to overcome the problem of complexity in CAD/CAM systems by incorporating Relational database features. The communication between the product design and manufacturing is automated with the help of secured data storage. The proposed optimization of CAPP based on the development of Relational database which ensures design of all the CAD data and safely stored in this database.

The relational database model is the fastest data structure. Optimizations built into an RDBMS, and the design of the databases, enhance performance, allowing RDBMSs to perform more than fast enough for most applications and data sets. Improvements in technology, increasing processor speeds and decreasing memory and storage costs allow systems administrators to build incredibly fast systems that can overcome any database performance shortcomings.

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