Computer Aided Design and Manufacturing

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Abstract— **CAD/CAM is a 21st century technology that related to the computer involvement in design and manufacturing. CAD/CAM is a latest technology developed in recent years. The CAD has main advantages over traditional methods, it enables the designer to examine a large number of design solutions and CAM simulate the work task may be performed in order to obtain the values of various performance measures in real manufacturing world.**
This paper discusses the advantages obtained from CAD/CAM integration. The applications of CAD/CAM integration used in CNC milling machine and virtual manufacturing operations have demonstrated the effectiveness of discuss methodology.

Keywords——**CAD, CAM, Virtual manufacturing, traditional method**

I. INTRODUCTION

Industrial world is witnessed the advent of computer-aided design (CAD) and computer-aided manufacturing (CAM) technologies which significantly improvement in product design and manufacturing. Although CAD and CAM have been significantly developed over the last three decades, they have traditionally been treated as separate activities. Many designers use CAD with little understanding of CAM. This sometimes results in design of non machinable components or use of expensive tools and difficult operations to machine non-crucial geometries. In many cases, design must be modified several times, resulting in increased machining lead times and cost. Therefore, great savings in machining times and costs can be achieved if designers can solve machining problems of the products at the design stage and developing stages. This can only be achieved through the use of fully integrated CAD/CAM systems.

CAD is defined as, ―the use of computer systems to assist in the creation, modification, analysis, or optimization of a design.‖ To perform the CAD operations the computer systems comprise of the software and the hardware. The hardware consists of all the visible components of the computer like processor, motherboard, mouse, keyboard, graphics card etc. The software consists of the program that can implement computer graphics on the computer system and also carry out a number of engineering functions on the computers.

The CAD software can carry out a number of engineering functions like analysis of stress-strain subjected on the components, dynamics response of the mechanisms, heat-transfer calculations, etc. Not all the CAD software will perform all the functions. Each CAD software is programmed to carry out specific function. Depending upon the type of the firm or the company, they will choose the CAD software that can perform particular application. However, the most popular CAD software are the ones that can perform design and drawing operations. This CAD software can perform all the designing operations like making various calculations, performing simulations of the designed components, checking them for stress etc. The drawings of these designed components can also be drawn using the CAD software, which help avoiding long and cumbersome process of making the drawings on the drawing board.

CAM is the acronym for Computer Aided Manufacturing. CAM is defined as, ―the use of computer systems to plan, manage, and control the operations of a manufacturing plant through their direct or indirect computer interface with the plant's resources.‖ In simple terms using the computers to carry out various manufacturing related activities is called as Computer Aided Manufacturing. The use of the computers can be to plan the manufacturing of the product, to carry out actual manufacturing of the product by linking the computers to machines and programming the computers, et

Integration of CAD and CAM is called as CAD/CAM. In the earlier days the CAD and CAM were considered to be two distinct technologies independent of each other, however, now there has been greater integration of CAD and CAM. CAD stands for Computer Aided Designing and CAM stands for Computer Aided Manufacturing. The combined CAD/CAM is the technology concerned with the use of computers to perform product designing and manufacturing operations.
Popular CAD Software.

These days a number of CAD software are available in the market, some of these include AutoCAD, CADopia, SolidWorks, Catia, Mathcad, Quick CAD etc. One of the most popular CAD software being used since years is AutoCAD. There are number of software uses for the CAM like, Magics, CATIA V5, Radan Sheet Metal CAD/CAM, SolidWorks, Alpha CAM etc. In these each software has the ability to make the program for CNC machine for manufacturing

II. BENEFITS OF THE CAD SOFTWARE

CAD software is being used on large scale basis by a number of engineering professionals and firms for various applications. The most common application of CAD software is designing and drafting. Here are some of the benefits of implementing CAD systems in the companies.

1) Increase in the productivity of the designer: The CAD software helps designer in visualizing the final product that is to be made, it subassemblies and the constituent parts. The product can also be given animation and see how the actual product will work, thus helping the designer to immediately make the modifications if required. CAD software helps designer in synthesizing, analysing, and documenting the design. All these factors help in drastically improving the productivity of the designer that translates into fast designing, lower designing cost and shorter project completion times.

2) Improve the quality of the design: With the CAD software the designing professionals are offered large number of tools that help in carrying out thorough engineering analysis of the proposed design. The tools also help designers to consider large number of investigations. Since the CAD systems offer greater accuracy, the errors are reduced drastically in the designed product leading to better design. Eventually, better design helps carrying out manufacturing faster and reducing the wastages that could have occurred because of the faulty design.

3) Better communications: The next important part after designing is making the drawings. With CAD software better and standardized drawings can be made easily. The CAD software helps in better documentation of the design, fewer drawing errors, and greater legibility.

4) Creating documentation of the designing: Creating the documentation of designing is one of the most important parts of designing and this can be made very conveniently by the CAD software. The documentation of designing includes geometries and dimensions of the product, its subassemblies and its components, material specifications for the components, bill of materials for the components etc.

5) Creating the database for manufacturing: When the creating the data for the documentation of the designing most of the data for manufacturing is also created like products and component drawings, material required for the components, their dimensions, shape etc.

6) Saving of design data and drawings: All the data used for designing can easily be saved and used for the future reference, thus certain components don't have to be designed again and again. Similarly, the drawings can also be saved and any number of copies can be printed whenever required. Some of the component drawings can be standardized and be used whenever required in any future drawings.

III. FUNCTIONS PERFORMED BY CAM

The functions performed by the computers systems in CAM applications fall under two broad categories, which have been described below.

1) Computer monitoring and control: In these applications the computer is connected directly to the manufacturing process for the purpose of monitoring or controlling the manufacturing process. Here the computer is fed with the program that directs the working of the machine, which is connected to it. Usually in such cases is no operator required to operate the machines, and they have to merely supervise the machine. At a time one operator can take care of more than one number of machines. These machines are also called as Computer Numerically Controlled (CNC) machines. These days the use of CNC machines has become very common. They can carry out the high quality production at a very fast rate that helps the companies remain competitive in the market.

2) Manufacturing Support Applications: In these applications the computer systems are used to assist in various productions related activities like production planning, scheduling, making forecasts, giving manufacturing instructions and other relevant information that can help manage company's manufacturing resources more effectively. There is no direct interface between the computers and the manufacturing process in this case.

In present scenario one just can't think of manufacturing any product without the use of computers in some or the other way. Either for designing of the product or manufacturing of the product, the use of computers has become compulsory. Since most of the companies do designing or drawing as well as manufacturing, the CAD/CAM has become an inseparable combination.

IV. COMPUTER AIDED DESIGN AND MANUFACTURING

All the products that have to be then manufactured, have to be designed first and they are sent for manufacturing. Let us see the important processes involved in CAD/CAM integration:

1) Designing of the product: First of all the product has to be designed by considering the applications desired from it and carrying out various stress and strain analysis. All these processes are carried out in the computers using appropriate CAD software. At the end of the designing process the product of appropriate shape and size is found designed.

2) Making the drawings: After designing the product, the assembly drawings and parts drawings of the product have to be made. These drawings are used for the reference purposes and more importantly for manufacturing the product on production shop floor. The drawings are also made by using CAD software.

3) Production planning and scheduling: The production planning and scheduling of the designed product can be carried out in the computers, which helps properly managing the manufacturing resources. There are some special product planning and scheduling software that can be used for this application. This is the CAM part of the product cycle.

4) Manufacturing the product: The manufacturing of the product can be carried by using the computers. The machines that are operated by the computers are called Computer Numerically Controlled or CNC machines. Nowadays the use of CNC machines has become very wide spread. In CNC machines the programming instructions for the manufacturing of the product that has been designed using the CAD software are fed. This program can also be fed directly from the CAD software into the computer of CNC machine. The program gives the appropriate instructions to the computer to carry out the manufacturing of the product as per the required dimensions.

The above CAD/CAM process clearly shows how important CAD and CAM are to each other. Both the applications support and complement each other to design and manufacture the product in better way and in shortest possible time.
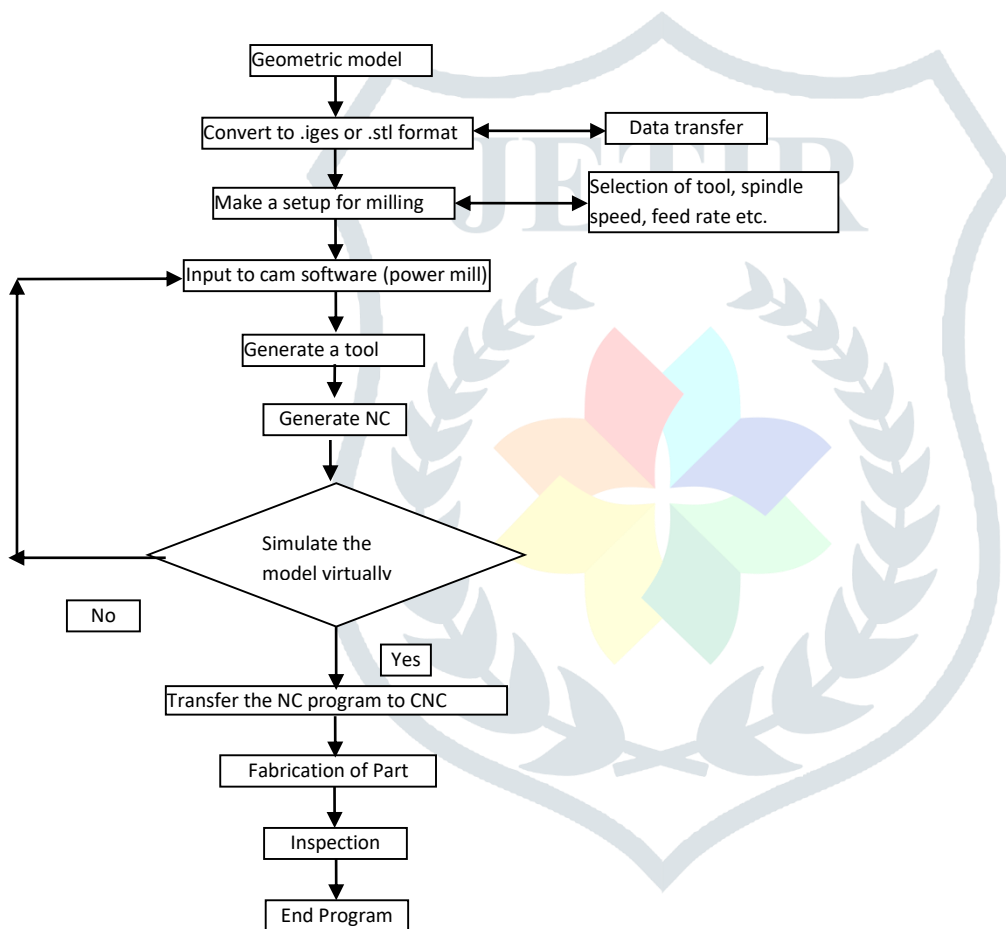
Flow Chart-

Fig.1 Outline of methodology step

Outline of methodology step/Algorithm-

☐   The suggested heuristic, which apply the new methodology, consist of three parts.

☐   The first part is based on the making the 3D model on the software (CATIA V5, NX.4, Pro-E)

☐   In the second part simulate the 3D model on the basis of manufacturing part programing and visual inspection on any software like CATIA V5, Pro-E, Delcam.

☐   In the third part the solution is obtaining it is check on the CNC OKUMA/EMCO milling machine.

☐   The process flow chart is presented in Fig.1.

V. CASE STUDY- Outline of methodology

Step1-Initialization

Make a feasible constructive solid geometry with proper dimensioning on software packages CATIA V5. (Pro-E, Uni-Graphics and transfer this file to STL, IGSE, step package.) The memento or sculpture model is shown in Fig-2
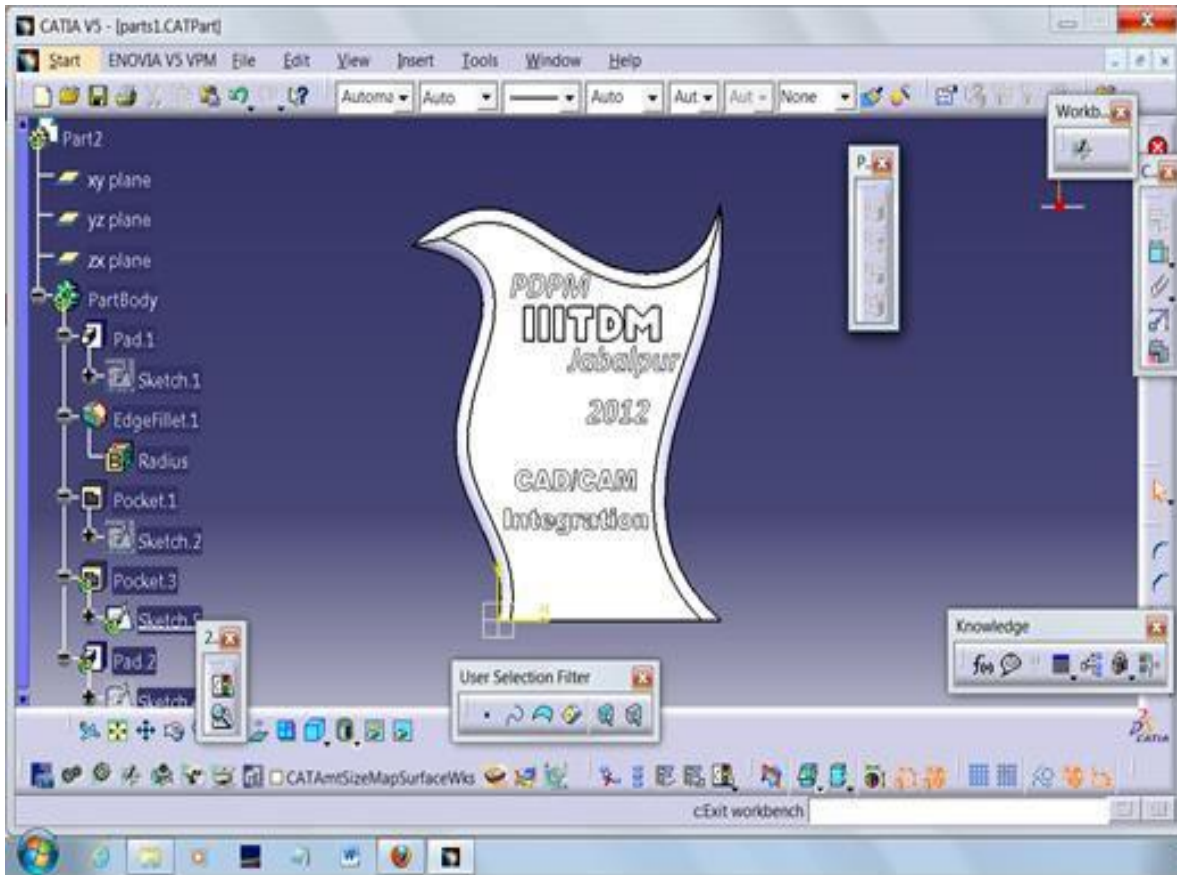
Fig-2 CAD model in Catia

Step-2 Input for generation of part program

Use STL, IGES file data as input for Delcam software. Make a input setup in the Delcam software (i.e. tool diameter, number of flank, shrank, tool holder.). Select the proper parameter and generate the part program.

Step-3 Generation of NC Program-

Generation of part program for different controller system of the following CNC machine- Ab84, bosch, boss, deckl3, dyna, fagor, fanuk, heid, kryle, Mazak, mistu, num, okuma, tiger, etc. The generated NC program is show in Fig-3.

Fig-3 NC Program

Step-3 Virtual Simulation of machining-

Simulate the part program on the Delcam software if it is wrong go for the parameter selection previous step and again generate the part program then go for the simulation if it is properly simulate then go to step-4. Fig-4 indicates the simulation
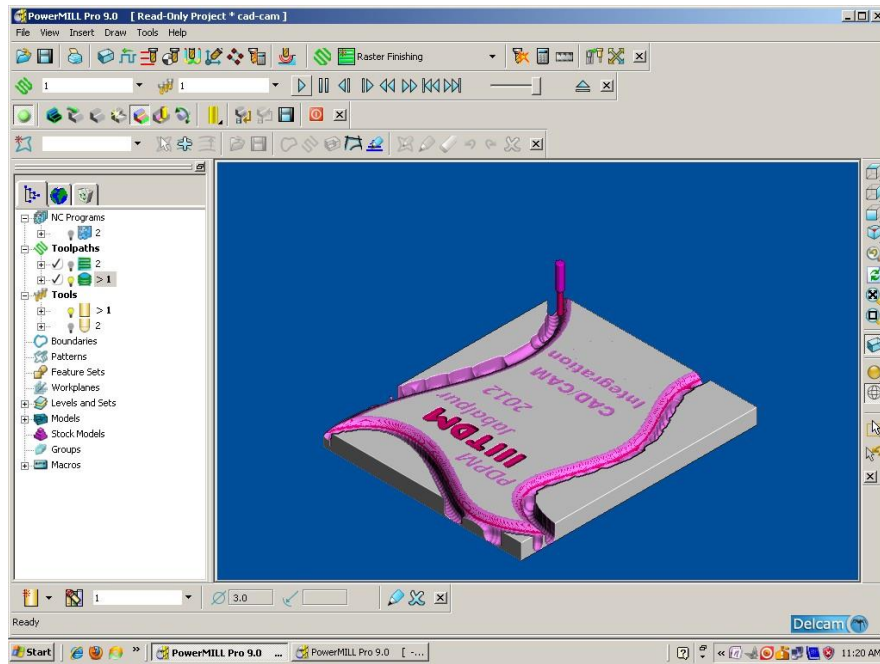
of NC program on software.

Fig-4 Virtual Simulation

Step-4 Fabrication on machine

This is the most important step in CAM, whatever we do on the software is properly implementing in actual machine or real world. By doing the proper fixture the work piece fix(set) it on table. Give the output of the Delcam (power mill) NC coding part program to CNC OKUMA milling machine & run the program block by block.

V CONCLUSION

In this work several goals have been achieved developing fully integrated CAD/CAM systems. It allows the user to manufacture to make 3D model of contouring profile which is not possible by conventional machine.

It gives the part program for the CNC/NC machine which reduces the hazardous effort of programmer also save time and paper cost for the programming. Finishing obtain by the machine is also increases because of good programming. So CAD/CAM integration is the best option in the future for complex manufacturing part.

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REFERENCES

[1]   Tehran. Iran (2006), An approach towards fully integration of CAD and CAM technologies, Journal of Achievements in Materials and Manufacturing Engineering, Volume- 18, issue 1-2.
[2]   Mikell P. Groover and Emory W. Zimmers, Computer Aided Design and Manufacturing, Publication Prentice-Hall, 1984.
[3]   Stroka, R. and Helis, A., Integration of CAPP and CAD/CAM systems, International Workshop CA Systems And Technologies. [4]   Balic. j. (2006), Intelligence CAD/CAM system for CNC programming-an overview, APEM Journal ISSN1854-6250
[5]   Patrick Waurzyniak (February 2010), CAD/CAM Software Drives Innovation, Manufacturing Engineering, Vol. 144 No. 2
[6]   Shuhua Yue, Guoxiang Wang, Fei Yin, Yixin Wang, Jiangbo Yang (2003), Application of an integrated CAD/CAE/CAM system for die casting dies, Journal of Materials Processing Technology 139 -465–468.
[7]   Programming manual(Okuma), Pub No. 5228-E-R8 (ME33-018-R9) Apr. 2009.
[8]   Power mill guide manual.