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Simulation and Modeling Analysis in Manufacturing Process

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Abstract - In the modern world class manufacturing it is of prime importance for modern management to make crucial decisions quickly and accurately to stand at the global competitive cutting edge. In many real life situations the main interest concern the prediction of how a system will perform under various conditions of change in the environment as well as with in the system. Experimenting on real system is not always feasible, so it is carried on some representative unit of the system. This unit is called a model and the process modeling. Simulation is a technique of systems modeling and analysis that involves mathematical models of a dynamic nature which are solved numerically. Simulation is a powerful and scientific method, which is widely, applied methodology for studying the behaviour of a variety of systems in order to develop solutions to problems in their design and operation. An overview of simulation modeling and analysis is recent advancements in this field, recommendations for selecting right simulation software, related technologies like artificial intelligence techniques, how they are integrated with computer simulation modeling and benefits due to development of these hybrid technologies.Computer simulation is one of the popular experimental investigation techniques as it involved reduced costs, time and risks compared to experimenting decision alternatives with real world system in real time. In the computer simulation, developing the models of the real systems on the computer has carried out experimentation. The use of simulation mathematical models has been proposed to reduce the computer costs of simulation while making use of its potential of predicting the performance of complex system.

Key words: Simulation, modeling, manufacturing process

I. INTRODUCTION

Modeling is the art of abstracting or representing the object, system or phenomenon. The geometric modeling is defined as the complete representation of an object with the graphical and non-graphical information [1-12]. It generates the mathematical description of the geometry and non-geometry of an object in the computer database and the image of an object on the graphic screen. Simulation is the process of developing a model (physical of mathematical) of a real system and conducting experiments with this model for the purpose either of understanding the behavior of the system or of evaluating the probable performance of the system within the limits by a criterion of set of criteria for the operation of the system [13-21].

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A model intended for simulation study is a mathematical model developed with the help of simulation software. Precisely, in the broader sense, simulation is a tool to evaluate the performance of a system, existing or proposed, under different configurations of interest and over long periods of real time. Simulation is used before an existing system is altered, or a new system built, to reduce the chances of failure to meet specifications, to eliminate unforeseen bottlenecks, to prevent under or over utilization of resources, and to optimize system performance [22-30].

II. METHODOLOGY - GEOMETRIC MODELING

Earlier CAD systems were basically automated drafting board systems which displays a two-dimensional representation of the object being designed, where as the objects are in general a 3D form, which the early CAD systems were unable to comprehend. Recent CAD systems(Software) have eliminated this problem by having the capability to store 3D data. The geometric modeling which allows the user to develop 3 dimensional models of an object on the graphics screen as well as in the computer database. It is the base of many CAD /CAM applications such as kinematical analysis of mechanical systems and finite element analysis, NC, CNC programming etc. The geometric modeling plays a major role in full integration and automation of CAD/CAM systems. There are three methods of geometric modeling such as

1. Wire-frame modeling
2. Surface modeling
3. Solid modeling

A. Wire Frame Modeling

A wire frame model of an object is the simplest but most were those geometric model that can be used to represent it mathematically in the computer. The word wire frame is related to the fact that one may image a wire that is bent to follow the object edges to generate the model. Typically a wire-frame model consists entirely of points, lines, arcs and circles, Conics and curves, connecting a finite set of points together with the edges. The usefulness of wire frame comes from the computer ability to calculate quickly and accurately the positions to the points(and hence also the edges)on the screens or plotter-paper. Wire-frame models are classified into three types

1. 2D Wire frame modeling
2. 2 1/2 D Wire frame modeling
3. 3D Wire frame modeling

There are two important aspects to the use of wire-frame models in CAD. The first is the computer representation of an object and this is concerned with the structure needed to encode a wire frame model. The second is concerned with the computation procedures needed to produce and manipulate the viewing of this representation. A computer representation for a wire frame consists of essentially two types of information. The first is the metric or geometric data which relate to the 3D co-ordinates positions of the wire frame node Points in space. The second is with the connecting or topological data which relate pairs of points together as edges.

B. Surface Modeling

A surface model of an object is a more complete and less ambiguous representation than its wire frame model. It is also richer in its associated geometric contents which make it more suitable for engineering and design applications. For example a surface model can be used to drive the cutter of a machine tool a wire frame can't. Surface systems were infact the CAD systems to raise the possibility of integrating the whole industrial process of design and analysis through to production and quality control using the computer as an intermediary.

Surface models take the modeling of an object one step beyond wire-frame models providing information on surfaces connecting the object edges. Typically, a surface model consists of wire frame entities that form the basis to create surface entities. Surface description is usually tackled as an extension to the wire frame representation.

Surface models are widely used in aircraft industry, ship building automotive manufacturing castings etc. In order to assist the visualization of a surface on a graphics display artificial fairing lines called mesh are added on the surface. The finer mesh size of surface requires longer CPU time to construct the surface model and to update the graphics display. The choice of the surface from depends upon the application. The surface entities are of two types, Analytic surface entity and synthetic surface entity.The analytic surface entities are plane surface, and surface of revolution. The synthetic surface entities are Bezier surface, B- spline surface, coons patch, fillet surface offset surface.

C. Solid Modeling

A solid model of an object is a more complete representation than its surface model. It is unique from the later in the topological information it stores which potentially permits functional automation and integration. A solid model consists of both the topological and geometrical data of its corresponding object. To eliminate all kinds of ambiguities in representation and manipulations of the objects, the solid modeler was developed. The completeness of the information contained in a solid model allows the automatic production of realistic images of a shape and automation of the process of interference checking. Further more interfaces can interrogate the model and extract of useful data. The model can also form as a means of geometric input for finite element analysis or even manufacturing tasks such as generation of instruction for numerically controlled machining.

There are two factors which promote future wide spread use of solid modelers. The first is the increasing awareness among users of the limitations of the wire-frame systems. The second reason is the continuing development of computer hardware and software which make solid modeling possible. Solid modelers require a great deal of computational power in terms of data speed and memory in order to operate. Two basic approaches to the problem of solid modeling have been developed are

1. Constructive solid geometry (CGS) also called as building block approach
2. Boundary representation (B-rep)

The constructive solid geometry [CGS] systems allow the user to build the model out of solid graphic primitives such as rectangular blocks, cubes, spheres, cylinders and pyramids. The most common method of stretching the solid model in the graphics data base is to use Boolean operations.The boundary representation approach requires the user to draw the outline or boundary of the object on the CRT screen. The user would slatch the various views of the object (front, side and top, more view if needed), drawing interconnecting lines among the views to establish their relationship. Various transformations and other, specialized editing procedures are used to define the model to desired shape.

Most of the CAD systems currently available offer extensive capabilities for developing engineering drawings. These capabilities includes

1. Automatic cross hatching of surfaces
2. Capability to write text on the drawings
3. Semiautomatic dimensioning
4. Automatic generation of bill of materials.

All of these features are helpful in reducing the time required to complete the design and drafting process.

III. MODELING SOFTWARES

There are many solid modeling software available to do the modeling, some of the familiar are given below as

1. IDEAS
2. PRO-E
3. SOLID-EDGE
4. IRON-CAD
5. SOLID WORKS
6. UNI-GRAPHICS

IV. SIMULATION ANALYSIS

Simulation may be defined as the process of developing a model is physical or mathematical of a real system and conducting experiments with this model for the purpose either of understanding the behavior of the system or of evaluating the probable performance of the system with in the limits imposed by a criterion of set of criteria for the operation of the system.

In many cases the models are used as a basis for simulation. Simulation is a very important field of computing whereby soft-wares may be designed to help simulate by making models, set up conditions and observe the results. Simulation is method used to study the dynamics of systems. The term systems is used to mean a group of limits which operates in some interrelated manner. The approach is applicable not only in engineering field but also in other fields such as medical science, nuclear science, agriculture, astronomy, Finance etc.

V. CONCLUSIONS

The steps involved in developing a simulation model, designing a simulation experiment and performing simulation analysis are identifying the problem, formulate the problem, collect and process input data, develop simulation model, validate the model, document model for future use, select the appropriate determine the sample size, performs the simulation runs, and collect, analyze and implement the results.This analysis for application of modeling and simulation techniques can be used in various areas in solving of practically oriented problems such as banking systems,

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traffic management, production, manufacturing, thermal problems, etc.
The out standing results of using this technique in critical field make this analysis even more beneficent than ever.Simulation is to mimic the real system by developing its theoretical model. A model should be a close approximation to the real system and incorporate its most of its salient features with appropriate assumptions. A good model is a judicious tradeoff between realism and simplicity. In the computer simulation, developing the models of the real systems on the computer has carried out experimentation. The use of simulation metamodels has been proposed to reduce the computer costs of simulation while making use of its potential of predicting the performance of complex system. Finally this concludes analysis, to view the mathematical modeling process in the simplest form as an iterative multi step process and the simulation in project network techniques, although very popular is found to yield overly optimistic results. Hence, computer simulation has been accepted as powerful decision making tool in the advanced manufacturing environment.

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