Development of a Virtual Simulator for Agile Manufacturing System

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Abstract

In this paper to cope with the reduction of products life-cycle as the variety of products along with the various demands of consumers, a virtual simulator is developed to make the changeover of manufacturing line efficient to embody a virtual simulation similar to a real manufacturing line. The developed virtual simulator can design a layout of a factory and make the time scheduling. Every factory has one simulator so that one product can be manufactured in the factories to use them as virtual factories. We suggest a scheme that heightens the agility to the diversity of manufacturing models by making the information of manufacturing lines and products models to be shared. The developed unit simulator can construct a proper virtual manufacturing line along with the required process of products using several kinds of operator and work cell. A user with the simulator can utilize an interface that makes one to manage the separate task process for each manufacturing module, change operator components and work cells, and easily teach tasks of each task module. The developed simulator was made for users convenience by Microsoft Visual C++ 6.0 that can develop a program supplying graphic user interface environment and by OpenGL of the Silicon Graphics as a graphic library to embody 3D graphic environment. Also, we show that the simulator can be used efficiently for the agile manufacturing by the communication among the factories being linked by TCP/IP and a hybrid database system made by a hierarchical model and a relational model being developed to standardize the data information.

1. Introduction

In recent industrial world to improve productivity factory automation through robot manipulators' adoption has been proceeding in overall industrial parts. Also as the globalization of the robot's utilization, the demand of the convenience of usage with its excellent performance is increasing. Furthermore the turbulent and changing environment has a great impact on all the manufacturing-related activities such as order, planning, shop floor control, and other management-related activities such as personnel, marketing, services, etc. Therefore manufacturers must put a stress not only on high quality, productivity, and reduced cost, but also on the ability to react quickly and effectively to changes in markets, production technology, and computer and information technology [1]. Agile manufacturing can be defined as a new paradigm of manufacturing emerging in the 90s which incorporates high productivity and quality into the various products satisfying maximally the customers under the unexpectedly changing market environment [2].

In this paper to cope with the reduction of product's life-cycle as the variety of products along with the various demands of consumers, a virtual simulator is developed to make the changeover of manufacturing line efficient to embody a virtual simulation similar to a real manufacturing line. The developed virtual simulator can design a layout of a factory and make the time scheduling. Every factory has one simulator so that one product can be manufactured in the factories to use them as virtual factories. We suggest a scheme that heightens the agility to the diversity of manufacturing models by making the information of manufacturing lines and product's models to be shared [3].

A virtual simulator developed in this paper can make change operator modules for each work cell on the basis of the composition of graphic modeling data of operators and perimeter equipments, and the interface that can realize task teachings and monitoring the requested product's model and the status of production in the other factories by means of the virtual simulators. A database system consists of an internal and an external database. An internal database system based on this preferred interface composites a static model or hierarchical model at first connected with the dynamic and kinematic features of the basic manufacturing components as tree-typed lower components. Also it is compensated by relational model pursuing dynamic connection with the data according to the modules that a user constructs without predetermining connections between data so that the study on the database can make the systemetic and standard data structure [4]. An external database system has the feature of a virtual system that build on every simulator but doesn't exist in a real system.

Also in case of the operator, especially robot manipulators, the simulator provides forward and inverse kinematic analysis, trajectory planning, simulation, and performance criteria and in case of a work cell, monitoring task time, delay time between modules, conveying speed of a work cell and so on [5]. The developed simulator was made for user's convenience by Microsoft Visual C++ 6.0 that can