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An Excellent Approach of Reconfigurable Machine Tool in Manufacturing System

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Abstract

The product designs and the required quantities change rapidly to meet the needs of customers. To maintain competitiveness in this uncertain environment, manufacturing companies need to possess agility to dynamically and effectively adapt to the changing environment. This paper presents the reconfigurable machine tools requirements and mechanical requirements. The design methods of reconfigurable manufacturing systems are also discussed in this paper

Keywords: reconfiguration, cost, modularity, manufacturing.

Introduction

Due to economy globalization, with the consequence the emphasis of competition, - individualization of needs, capital dynamization, generates high requirements concerning investment efficiency, high versatility of small companies, for fast adaptation to market. At the time, the company's responses to these changes are based on the idea of extending some of the attributes of classic manufacturing system to define reconfigurability [1]. The nowadays CNC control system is inappropriate to consider as basis for the control of RMTs. Existing CNC systems support only CNC builder specific NC program input and this limits the potential application of many NC programs that have the same functions with different formats varying one machine to another. In the case of the RMT, where there is a wide range of configurations, using nowadays programming standards will be time consuming. Because of the issues of software reconfiguration the ramp up time is considerable. In nowadays CNC systems, the NC program processor is a very important component that determines the accurate resolving of machining intention

generated from a CAM system. The major functions of CNC processor include checking the syntax and decoding them into specific outputs such as motion command, PLC command, parameter setting, or error messages [2].The conventional approach for surface machining is to use a series of straight lines to approximate the part surface. These straight lines are subsequently translated into linear G codes by the computer aided machining (CAM) software, and then sent to the computer numerical control (CNC) system. Moon et al. [3] state "machine tools are created to fit the function and the performance required to perform a set of operations." This statement is counter to the typical design of machine tools; whereby, a machine tool is designed and a process plan is developed after the machine is designed.

Reconfigurable control requirement

The control components of dedicated machine tool are customized for the dedicated machine tool requirements and thus do not contain unnecessary compatibility and are corresponding robust. However these components can not be cost effective upgraded. Typically CNC controller's have comprehensive architectures to provide processing flexibility. However not all of the built in functionality may be used. Thus unnecessary costs are incurred due to software development, installation. Similar to its mechanical components, CNC controller processing is applicable [4]. For dedicated manufacturing tool and CNC , the control components are not modular and thus they are not scalable nor upgraded and new technology can not be cost effectively integrated. The controller of reconfigurable machine tool must be based on the concept of open architecture. In open architecture control, the software architecture is modular and thus hardware components and software components can be easily added and removed and controller can be cost effectively reconfigured. The reconfigurable machine tool controller modularity allows the controller to be customized to its current operation requirements and thus to be robust and reliable while machining the ability to be reconfigured [5].

Reconfiguration requirement introduce several challenges of RMT controller. The challenge is the reconfiguration of controller architecture that is required when the physical machine tool is reconfigured or new technology is integrated. Unlike dedicated machine tool or CNC controller architecture is dynamic. The challenges are the control of RMT with machine tools working independently. To handle the challenge of cost effective reconfiguration of RMT controllers work on a software tool known as a control configuration is being developed and is currently being applied to a prototype model.

Reconfigurable mechanical requirement

For a machine tool to meet the productivity and quality demands of an operation it must fulfill a variety of requirements including the ability to produce the specified motions. The following are the mechanical requirements of reconfigurable machine tool [6].

Kinematics viability

This is the main requirement of reconfigurable machine tool. The kinematics viability means the machine tool must be able to perform the motions required to produce the features set for a dedicated machine tool the minimum required degree of freedom is designed given the feature set to be machined. So the kinematics configuration is limited. A methodology has been developed to determine the reconfigurable machine tool requirements automatically. The machining operation is transferred in to task matrix that contains the necessary motions requirements for the machine tool [7]. The functions requirements of the machining operation are used to generate the graph representations.

Structural stiffness

Reconfigurable machine tools are designed such that the structural stiffness requirement is ensured. The structural stiffness must be guaranteed for all configurations. The RMT may take and all the operations that may be performed. The RMT joints in general will be designed such that mechanical modules may be cost effectively rearranged and thus the joints can be treated as rigid [8]. Therefore the joint stiffness will dramatically affect the overall machine tool structural stiffness and must be carefully taken in to account during the further stages. The critical parameters such as cutting force are identified for the range of possible operations .But in reconfigurable manufacturing machines design problem can be divided into two sub-problems, a) the machine architecture design problem and b) the machine configuration design problem. The machine architecture design problem deals with the structure of the machine from which different configurations can be derived. The configuration design problem deals with identifying the appropriate machine configuration for a particular product.

Design Methods for Reconfigurable manufacturing system

Three types of design methods for RMS are architecture, configuration, and control design. Architecture design refers to the design of machine components and interactions [9]. Configuration design refers to the identification of single machine configuration or system level, multiple machine configurations to accommodate product requirements. Control design relates to the design of software which governs the operation of the machining system from an entire manufacturing system level down to individual component control.

Conclusion

This paper concludes that the reconfigurable machine tool provides a viable solution for the manufacturing situations where operations requirements change with in prescribed bounds over the life time of the machine tool. RMT are customizing to

their current operation requirement. The mechanical and control requirements are very necessary to upgrade of reconfigurable machine tool in manufacturing industries.

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