Literature Review for Designing of Portable CNC Machine

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Abstract

This paper discussed of literature review of different author who have tried to build the smaller CNC machines. Today CNC technology has major contribution in industries. CNC machines are main platform in the contribution of good quality products in industries. Basically CNC machines are automated operating machines which are based on code letters (NC etc.), numbers and special characters. The numerical data required for manufacturing a part provided by machine is called CNC (Computer Numerical Controlled).

Keywords: CNC machine, Design Calculation, Review etc.

I. INTRODUCTION

In the last few years, lot sizes have decreased dramatically as many manufacturing firms have adopted the just-in-time manufacturing philosophy. As a result, the suppliers of machined parts both captive machining departments and contract machine shops to these firms have required machine tools that can be set up faster for the next job. They have required machine tools that enable them to respond faster to customer orders and at the same time more readily accommodate part design changes. The machine tool manufacturers have had to fulfil these customer requirements in order to stay competitive. What follows is a look at some of the major improvements that have been made to CNC multi-spindle screw machines as a result.

The setup of high-production, multi-spindle screw machines has always been a time-consuming process. However, controls for CNC multi-spindle screw machines have improved tremendously in the last decade. An important benefit of these improvements is a marked reduction in setup times. Today's CNCs are as powerful as the newest and best PC. In fact, the PC has become an integral part of the machine.

II. LITERATURE REVIEW

Linyan Liu et al. (2014) presents a knowledge-centric process management framework for the CNC machine tool design and development (D&D) with the integration of process and knowledge. Requirements for the framework are generated based primarily on the nature of the machine tool design practice. The proposed framework consists of process integration model, process simulation, process execution and knowledge objects management modules. Each of these modules is elaborated to support the knowledge-centric machine tool development process management. The prototype development is also presented by the author. Results of this study facilitate the knowledge integration in CNC machine tool D&D, and thus increase machine tool development capability, reduce development cycle time and cost, and ultimately speed up the effectiveness and ensure the excellent machine tool development. Finally the study has outlined a framework within which designers are encouraged to participate in the machine tool development efficiently and conveniently, for the benefit of each individual and the company. Compared with the existing references, the proposed framework of knowledge-centric CNC machine tool D&D process management includes the following results:

Based primarily on the nature of the machine tool design practice, requirements for the knowledge-centric frame-work with integration of process and knowledge are analyzed in consideration of the design objects, the D&D process, the knowledge-centric demand and its implementing and monitoring demand. Then, the framework of knowledge-centric CNC machine tool D&D process management used in the CNC machine tool industry is proposed, which includes the modelling, simulation and its execution and takes the knowledge into consideration. The design process of KVC1050N Vertical machining center is also studied as an example to demonstrate the feasibility and availability of the proposed framework. The results of this study significantly contribute to efforts to achieve knowledge and process integration in CNC machine tool D&D. In a word, ongoing efforts are being taken to make the framework more practical in the industrial application. Thus, this solution can serve machine tool companies in this important industry sector by increasing machine tool development capabilities, improving work efficiency and ultimately reducing development cycle time and costs. [1]

Venkata Krishna pabolu et al (2010) discuss the design and implementation of low cost three dimensional computerised numerical control system (CNC) for industrial application. In this paper prototyping an Embedded CNC machine was created

.Detail description of different modules such as software development, Electronic/Electrical development, along with technical details of their implementation have been given. [2]

Dr.J.B. Jayachandraiah et al (2014) provide the idea to develop the low cost Router system which is capable of 3 axis simultaneous interpolated. The low cost is prototyping is achieved by incorporating the features of standard PC interface with microcontroller base CNC system in an Arduino based embedded system. With limited budget the author conclude that small machine tools to fabricate small parts can provide flexibility and efficiency in manufacturing approach and reduce the capital cost, which is beneficial for small business owners. [3]

Ahmed A.D.Sarhan et al. (2015) in this paper, an initial CNC gantry milling machine structure with the potential to produce high surface finish has been designed and analyzed. The target of the author is to achieve lowest natural frequency of 202Hz corresponding to 12000 rpm at all motion amplitudes with a full range of suitable frequency responses. Modal analysis of the initial gantry structure design was performed and its natural frequency was 102.36HZ. To improve the dynamic behavior of the gantry structure so it can endure at frequencies above 200HZ, a modification process was carried out to increase stiffness. The above enhancement, appropriate behavior was attained. Deformation of less than 10 microns ensued at the tip of the spindle when the minimum natural frequency of the gantry structure rose slightly above 200Hz. An increase in the structure's weight was the significant factor for the identified deformation. However, the variation did not have a negative impact on the precision of the machine. As a result, the weight increased after modifications to the gantry structure were made, while the amount of deformation and overall dynamic behavior improved. In addition, the efficacy of the Z-axis part's position on the dynamic behavior of the gantry structure was studied. By displacement of the spindle position, the dynamic behavior of gantry structures will change. Evaluations on the gantry structure's behavior demonstrated that the least natural frequency occurred while the Z-axis part was located below the middle of the beam. This signifies that the structure was in a critical situation. The results shown by the author, that according to the critical condition, the minimum frequency of the structure is acceptable. The research results shows that the designed CNC gantry machine is capable of functioning at a speed of 12,000rpm. [4]

Nikita R. Saharkar et al. (2013) design the CAD Model in Solidworks and Done the FEA analysis in hyper mesh tool providing the appropriate constrains, loads, and moment values. According to the author he got the stress value around 14 Mpa which is less than the allowable stress value of M.S. concluding the design is safe. Author also generate the G & M codes by simulating the CAD file in Power mill software which is nothing but the CAM software. [5]

Sundar Pandian et al. (2014) develop low cost 3 axis CNC machine using of- the- shelf component, stepper motors with drivers, Arduino open source, microcontroller and open source motor control software. Author used ready to assemble kit from Zen Tool works, USA. Kit provided stepper motor, lead screw, guide rod, anti-backlash falans and spring. He made the Body with high density PVC. The machine has fix gantry and mobile bed so there is restriction in working area. Author develop Low cost CNC machine only for educational purpose. [6]

B.Malleswara Swami et al. (2012) in this paper author describe the method for static and dynamic analysis. Author used standard bed for analysis. The investigation is carried to reduce the weight without changing the structural rigidity and the accuracy by adding the ribs at the suitable location. Static analysis is done for 1g i.e. gravitational force is consider with external load on structure and 5g i.e. gravitational force 5 times 'g' value is applied on structure along with external load .In modal analysis ,the natural frequency of the body is evaluated to find the dynamic and vibration characteristics. Then the optimize design is generated using optistruct tool. The results which gets after optimization reduces the weight by 1.55% with original value and average frequency shifted by appx. 8.8 % with 1st natural frequency. [7]

Druv Patel et al. (2014) studied influences of various parameter like tool speed, tool feed and depth of cut on CNC router and concluded from ANOVA that percentage contribution of feed rate is maximum and it means Feed rate is the most dominating factor for modelling surface finish. [8]

Monika Nowak et al. (2012) formulated methods of selection of geometric and physical structure of the mobile machine by specifying the design requirements and the development of the elimination conditions based on these requirements. The selection procedure was based on an analysis of the functional description of the required shaping movements, carefully developing appropriate conditions for the elimination of alternatives using the information concerning the needs of future portable machine operators. [9]

Grzegorz szwengier et al. (2012) gives the results of research on selection on geometric-kinematic structure of newly designed milling machine. There was various types of structure combination available for milling machine, author suggested best procedure and help to select useful combination of machine parts with desired output provided with constraints of machine. [10]

III. CONCLUSION

After reviewing above papers we can say that, CNC machine tools must be better designed and constructed, and must be more accurate than conventional machine tools. It is necessary to minimize all non-cutting machine time, by fast tool changing methods, and minimize idle motions by increasing the rapid traverse velocities to make the use of the machine tool more efficient. Digital control techniques and computers have undoubtedly contributed to better accuracy and higher productivity. However, it should be noted that it is the combined characteristics of the electric control as well as the mechanical design of the machine tool itself that determine the final accuracy and productivity of the CNC machine tool system. High productivity and accuracy might be contradictory. Because high productivity requires higher feed, speed and depth of cut, which increases the heat and cutting forces in the system. This will lead to higher deflections, thermal deformations and vibration of the machine, which results in accuracy

deterioration. Therefore, to achieve high operating bandwidth while maintaining relatively high accuracy, the structure of CNC machine tool must be more rigid and stiff than its conventional counterpart.

To achieve better stiffness and rigidity of structure, several factors should be considered in the design. The first concern is the material. Conventional machine tools are made of cast iron. However, the structures of CNC machines are usually all-steel-welded, constructed to achieve greater strength and rigidity for a given weight. In addition, better accuracy is obtained in CNC machines by using low-friction moving parts, avoiding lost motions and isolating thermal sources. Regular sliding guides have higher static friction than the sliding friction. The force used to overcome the static friction grows too large when the guide starts to move. Due to inertia of the slide the position goes beyond the controlled position, adding overshoot and phase lag to the system response, and affects the accuracy and surface finish of the part. This can be avoided by using slides and ball screws in which the static friction is lower than the sliding friction for example, rolling type parts such as ball-bearing ball screw and recirculating linear slides can be used.

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