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# Retrofitting of CNC and Drive in Lathe Machine

P.Manikandan , K.Lakshmi Priya , K.Kalpana Devi

*Abstract*— The development of modern technologies in computer software , hardware , and firmware as well as the integration of these technologies in the industrial lines have proved better and more efficient productions can be machined.

Products can be produced by modern technology, which uses computer software, hardware and firm ware in industries. It is needed to use CNC lathe machine to get more accurate dimensions and irregular shape. So, CNC machines are becoming more and more important in modernized industrialization. There are many conventional lathe machines in our country. To build a new modern developed country, it is required to convert these conventional lathe machines into semi-automatic control lathe machine by retrofitting. Developing and changing into semi-automatic control lathe machine, there are three required portions, namely, mechanical, electronics and hydraulic. In this project we convert the convention lathes which have 5ft bed length in to the semi-automatic lathe.

In mechanical side we replace the ball screw in place of lead screw for better accuracy and remove some unnecessary component like gears for providing space for motors. We add an extra plates or structure for installation of motors. Also provides a hydraulic circuit for coolant. In electronic side we used a servo/ stepper motor for both Z and X axis and provide controller for the efficient operation.

***Keywords*** — Automation, Retrofitting, CNC.

## I. INTRODUCTION

Retrofitting refers to the addition of new technology or features to older systems this definition gives an almost all information about the word retrofitting. When we say that retrofitting related to some component that mean we try to upgrade that component and improve their efficacy through a present technology. But here we only talks about the retrofitting in lathe machine at time Retrofitting is the process of replacing the CNC, servo and spindle systems on an otherwise mechanically sound machine tool to extend its useful life. Rebuilding and remanufacturing typically include a CNC retrofit. The anticipated benefits include a lower cost investment than purchasing a new machine and an improvement in uptime and availability. But there are often other unanticipated benefits to retrofitting including lower energy costs, higher performance and a new level of manufacturing data accessibility.

Assuming the machine tool is generally in good shape mechanically, CNC retrofitting is typically the lowest cost solution to improve the overall performance of an older machine tool.

## II. AC DRIVES

An ac drive is a device that is used to control the speed of an electrical motor. The speed is controlled by changing the frequency of the electrical supply to the motor. The three-phase voltage in the national electrical grid connected to a motor creates a rotating magnetic field in it. The rotor of the electrical motor will follow this rotating magnetic field. An ac drive converts the frequency of the network to anything between 0 to 300Hz or even higher, and thus controls the speed of motor proportionally to the frequency. The technology consists of :

Rectifier unit: The ac drive is supplied by the electrical network via a rectifier. The rectifier unit can be uni- or bidirectional. When unidirectional, the ac drive can accelerate and run the motor by taking energy from the network. If bidirectional, the ac drive can also take the mechanical rotation energy from the motor and process and feed it back to the electrical network.

Dc circuit: The dc circuit will store the electrical energy from the rectifier for the inverter to use. In most cases, the energy is stored in high-power capacitors.

Inverter unit: The inverter unit takes the electrical energy from the dc circuit and supplies it to the motor. The inverter uses modulation techniques to create the needed three-phase ac voltage output for the motor. The frequency can be adjusted to match the need of the process. The higher the frequency of the output voltage is, the higher the speed of the motor, and thus, the output of the process.

## III. DC DRIVE

DC drive is basically a DC motor speed control system that supplies the voltage to the motor to operate at desired speed. Earlier, the variable DC voltage for the speed control of an industrial DC motor was generated by a DC generator.

By using an induction motor, the DC generator was driven at a fixed speed and by varying the field of the generator, variable voltage was generated. Soon after this Ward Leonard set was replaced by a mercury arc rectifier and later by thyristor converters.

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## IV. COMPUTER NUMERIC CONTROL (CNC)

CNC plays the major role to operate the next generation machine. We also use this concept in our project to convert the automatic manufacturing machine into automatic computer integrated manufacturing machine.

Numeric control can be defined as a form of programmable automation, in which the process is controlled by the numbers, Letters and symbols. In NC, the numbers form a program of instructions designed for a particular work part or job. When the job changes instruction of program is changed.This ability to change the program for each new job is what gives NC its flexibility. It is much easier to write new program then to make production equipment.

NC technology is applied to variety of operations including drafting, assembly Inspection, and sheet metal press working and welding. However NC finds its principle application in metal machining process.CNC is an NC system that utilizes the dedicated, stored program.

Computer to perform some or all of the basic numeric control functions. Because the trend towards downsizing in computers, most of the CNC system sold today used a microcomputer based controller unit. Over the year's microcomputer have also been used in CNC controls.

The external appearance of the CNC machine is very similar to that of conventional NC machine. Part programs are initially entered in a similar manner. Punched tapes are still the common device to input the programming to the system. However, with conventional numeric control, the punched tape is cycled through the reader for every work piece in the batch. With CNC, the program is entered once and then stored in the computer memory. This tape reader is used only for the original loading of the part program data. Compared to regular NC, CNC offers additional flexibility and computational capability. New system operations can be incorporated in the CNC controller by simply by reprogramming the unit. Because of this, it has reprogramming capacity both in terms of part programs and system control options.

Fig1 CNC Machines

## V. SIMULATION RESULTS

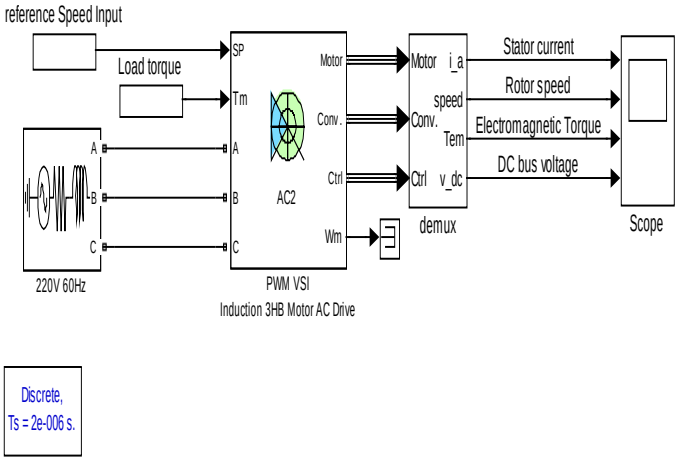


Fig.2 Simulation of PWM VSI Induction Motor Drive

### *A. Circuit Description*

This circuit Uses the AC2 block of SimPowerSystems™ library. It models a PWM VSI induction motor drive with a braking chopper for a 3HP AC motor. The induction motor is fed by a PWM inverter, which is built using a Universal Bridge Block. The speed controller consists in a PI regulator that produces a slip compensation, which is added to the rotor speed in order to derive the commanded stator voltage frequency. A constant volts per hertz ratio is also applied to the motor. The motor drives a mechanical load characterized by inertia J, friction coefficient B, and load torque TL.Motor current, speed, and torque signals are available at the output of the block.

### *B. Demonstration*

Start the simulation. You can observe the motor stator current, the rotor speed, the electromagnetic torque and the DC bus voltage on the scope. The speed set point and the torque set point are also shown.

At time t = 0 s, the speed set point is 1000 rpm. As shown in Figure 0-10, the speed follows precisely the acceleration ramp. At t = 0.5 s, the full load torque is applied to the motor shaft while the motor speed is still ramping to its final value. This forces the electromagnetic torque to increase to a high value and then to stabilize at 11 N.m once the speed ramping is completed and the motor has reached 1000 rpm. At t = 1 s, the speed set point is changed to 1500 rpm and the electromagnetic torque reaches again a high value so that the speed ramps precisely at 1800 rpm/s up to 1500 rpm under full load. At t = 1.5 s, the mechanical load passed from 11 N.m to -11 N.m , which causes the electromagnetic torque to stabilize at approximately at -11 N.m shortly after. Note that the DC bus voltage increases since the motor is in the braking mode. This increase is limited by the action of the braking chopper.

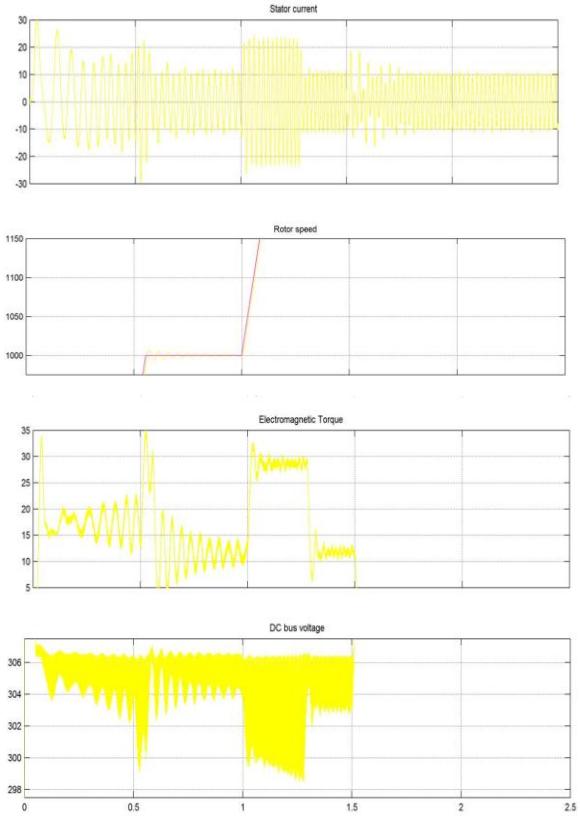


Fig.3 Waveform of PWM VSI Induction Motor Drive

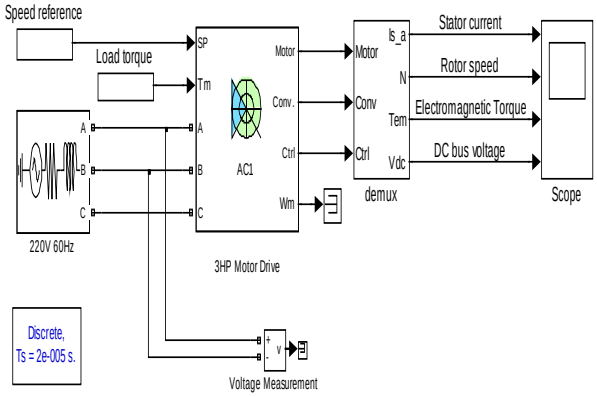


Fig.4 Simulation of Six Step Induction Motor Drive

### *C. Circuit Description*

This circuit uses the AC1 block of SimPowerSystems™ library. It models a six-step induction motor drive with a braking chopper for a 3HP AC motor.The induction motor is fed by a voltage source inverter, which is built using the Universal Bridge Block. The DC bus voltage is produced by a thyristor rectifier and regulated using a PI controller in order to maintain a constant volts per hertz ratio. A braking chopper limits the DC bus voltage increase during motor deceleration or when the load torque tends to accelerate the motor. The motor drives a mechanical load characterized by inertia J, friction coefficient B, and load torque TL.

Motor current, speed, and torque signals are available at the output of the block.

### *D. Demonstration*

A speed reference step from 0 to 1800 rpm is applied at t = 0. The speed set point doesn't go instantaneously at 1800 rpm but follows the acceleration ramp. The motor reaches steady state at t = 1.3 s. At t = 2 s, an accelerating torque is applied on the motor's shaft. You can observe a speed increase. Since the rotor speed is higher than the synchronous speed, the motor is working in the generator mode. The braking energy is transferred to the DC link and the bus voltage tends to increase. However the over voltage activates the braking chopper which causes the voltage to reduce. In this example, the braking resistance is not big enough to avoid a voltage increase but the bus is maintained within tolerable limits. At t = 3 s, the torque applied to the motor's shaft steps from -11 N.m to +11 N.m .You can observe a DC bus voltage and speed drop. At this point, the DC bus controller switches from braking to motoring mode. At t = 4 s, the load torque is removed completely and the electromagnetic stabilizes around zero shortly after.

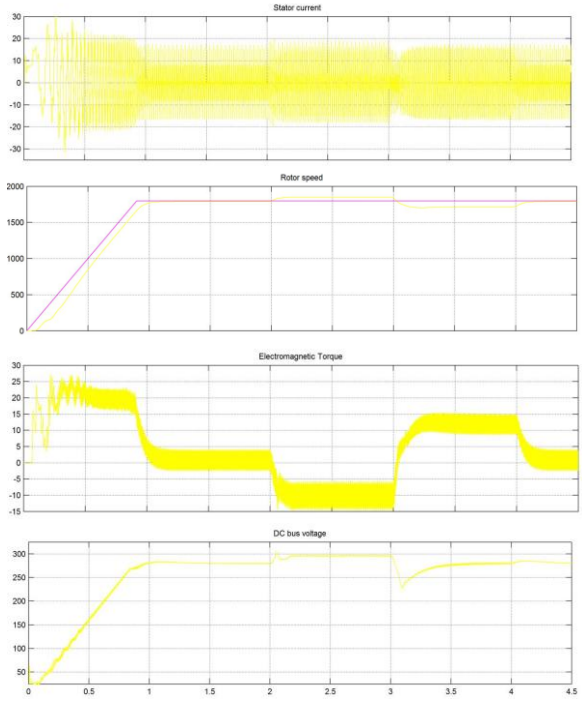


Fig.5 Waveform of Six Step Induction Motor Drive

## VI. CONCLUSION

In this paper, the automated new developed retrofitted lathe is done by replacing or removing the components from conventional lathe machines. And we retrofitted CNC and dc to ac drive in lathe machine, therefore setup costs high as compared to standard lathe machine but production rate is too much high. So it is very useful for mass production. And also the simulation was done to show that ac drive will give a smooth operation of motor and reduces maintenance cost.

The accuracy of the job manufactured in retrofitted lathe machine is also high so repeatability and dimensional stability

of manufactured part is achieved. CNC machines can be used continuously 24 hrs a day, 365 days a year and need to be switched off for occasional maintenance. CNC machines are programmed with a design which can then be manufactured product will exactly be the same.

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