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CNC Machine Design, Fabrication and Control: A DC Serov Motor Based System

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Controlled Numerical Computer (CNC) machines technology is one of the most important modern technologies for metal and wood forming industries. A CNC machine is fully automated system using digital electronics, which enables it to preform very accurate tasks with high production rates. A typical CNC machine consists of 3 main parts, the spindle to spin the cutting tools for forming objects; the frame and table to place the work object and carry most of the parts of the machine including the gantry, motors, guide rails and electronics parts; the gantry, which consists of the moving perpendicular axes, to enable the spindle to move in the three directions x, y, z; and the microprocessor to generate appropriate commands to all the moving parts of the machine. The displacement accuracy of the three axes of the machine is the major factor that affects the quality of its products. In most of CNC machines, such displacement is performed using stepper motors, which are often controlled in open-loop, therefore, actual positions of the three axes cannot be used to improve the performance of the machine in general. Moreover, stepper motors consume large amount of energy, which reduces the overall efficiency of the machine. In this study, we propose the design, fabrication and control of a prototype CNC machine based on DC servo motors and feedback control systems. For such machine, actual measurements of the three axes positions are feedback to the control system which are compared with the desired positions, then, the error can be used to generate the appropriate commands to the motors to improve the accuracy of operation and also to reduce effects of the vibrations, disturbances and noise. Moreover, the energy consumption can be easily controlled in feedback system.