A Virtual Test Bed Implementation Using the Precision Model of Feed-Drive System for the Verification of Command Generators

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Abstract

In this paper, a simulation model of a CNC feed-drive's servo-control system, which could be utilized to design and develop CNC controllers, is presented. For the first time, a precise model of machine tools components and controller, which we may call virtual machine, is employed as an experimental aid to carry out practical and economical tests for verifying command generation modules.
In most of the previous research in order to carry out experimental test of trajectory generators, the presence of real CNC machine is needed. However, to reduce the cost and the risks associated with the practical test, using the simulation method could be suitable. The combination of simulated machine tool components and controller could be used instead of real CNC machine as a virtual one to do some other experiment such as the command generator tests.
Therefore, a three-axis CNC machine feed drive is implemented in a MATLAB/SIMULINK environment and its performance will be verified. The effects of some of the main variables on the system's performance such as coulomb friction, viscous friction, feed force and inertia are analyzed and the PID controller is employed and tuned to reach the required performance. Previously generated NURBS commands based on jerk-limited trajectory are used as input to verify the validity of simulation.
The test results revealed the advantages and capabilities of the purposed simulated feed drive model. Also it could be a convenient test bed for other experimental purpose in application of CNC feed drive and controller.