Proceedings of the 2008 International Manufacturing Science and Engineering Conference
MSEC2008/ICMP2008
October 7-10, 2008, Evanston, Illinois, USA

MSEC2008-72374

FORCE/VELOCITY CONTROL OF A PNEUMATIC GANTRY ROBOT FOR CONTOUR TRACKING WITH NEURAL NETWORK COMPENSATION

Mohammed Abu-Mallouh
Department of Mechanical and Materials Engineering
Queen's University, Kingston, Ontario
K7L 3N6, Canada
mallouh@me.queensu.ca

Brian Surgenor
Department of Mechanical and Materials Engineering
Queen's University, Kingston, Ontario
K7L 3N6, Canada
surgenor@me.queensu.ca

ABSTRACT

In this paper, the application of a pneumatic gantry robot to contour tracking is examined. A hybrid controller is structured to control the contact force and the tangential velocity, simultaneously. A previous study provided controller tuning and model validation results for a fixed gain PI-based force/velocity controller. Performance was limited by system lag and Coulomb friction. New results demonstrate that even with perfect friction compensation, the limiting factor is the system lag. A neural network (NN) compensator was subsequently developed to counter both effects. Results for straight and curved edged workpieces are presented to demonstrate the effectiveness of the NN compensator and the capabilities of a pneumatic gantry robot.

Jatta et al have extensively investigated the application of force/velocity controllers, and the various elements that impact on system performance. For example in [7], they showed the importance of joint friction. Problems due to elasticities in joint transmissions were examined in [8]. Jatta's force/velocity controller is considered an appropriate controller for planar contour tracking applications of workpieces with unknown geometries. Thus, its basic structure has been adopted for the application addressed in this paper.

Considerable research has been conducted on force control with electric robots. By contrast, little research has been conducted on force control with pneumatic robots. This is understandable as pneumatic actuators are more difficult to control because of low bandwidth and high nonlinearity due