MED-Vol. 8, Proceedings of the ASME
Manufacturing Science and Engineering Division — 1998
ASME 1998

TECHNOLOGIES FOR FLEXIBLE FIXTURING AND HIGHER SPEED PART HANDLING IN AUTOMATED AUTOMOTIVE SHEET METAL ASSEMBLY

Gary M. Bone and Ka-Ming Yuen
Department of Mechanical Engineering
McMaster University
Hamilton, Ontario, Canada, L8S 4L7
gary@immrc.mcmaster.ca

ABSTRACT

A lack of fixturing flexibility and of high speed handling of non-rigid parts are two important problems in automotive sheet metal assembly operations. This paper describes the development of two unique grippers for flexible fixturing of automotive sheet metal parts, and of two methods for the vibration control needed for high speed handling of non-rigid parts. Each gripper is designed to execute a 3-D fixturing strategy which does not require accurate initial part placement, and provides a large number of valid fixturing solutions. Both grippers are tested on several automotive parts. With the first design, the average standard deviation of the parts' location before fixturing of 0.5 mm was reduced to 0.01 mm after fixturing. The methods of vibration control may be used with most of the industrial robots used for part handling. At a speed of 1 m/s the LEC method reduced the vibration amplitude by 33% after four learning trials. At 0.5 m/s the ICS method reduced the vibration amplitude by 60% and the settling time by 67%.

1. INTRODUCTION

Automotive sheet metal assembly currently requires the use a large number of fixtures to locate and immobilize the parts for joining by spot welding. The cost of redesigning, manufacturing, and installing these fixtures for model changes is substantial (on the order of $100 million/plant/year [1]) and would be significantly reduced if a more flexible alternative was developed.

A further difficulty in the assembly process is encountered when large, non-rigid, body panels must be moved rapidly by robots. To prevent excessive vibrations from occurring that could damage the part or result in assembly errors, the motion speed is reduced, dwells are added and specially designed grippers are used. These grippers use a large frame and several vacuum pickups to support the part. Each gripper must be designed and manufactured for a particular part's size and shape, and to avoid interference with the subsequent welding operation. A much more flexible and cost effective alternative would be to use a small generic gripper which would not require redesign for