A Robot Kinematic Gripper

by

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ABSTRACT

A unique kinematic gripper, based upon a design by Chase et al (1), has been constructed and commissioned in the laboratories of Queen's Mechanical Engineering. The gripper is part of the robotic equipment at Queen's Mechanical Engineering and is used in the development of end effector sensors (2,3 and 4). It is mounted on a PRAB VERSATRAN, 110 Kg capacity hydraulic robot.

This paper describes the design of the gripper, the sensor integration process and the development and testing of the gripper control system.

INTRODUCTION

Grippers, a subset of end effectors, are the means by which a robot accomplishes its task. Grippers are the end effectors that actually grip a part while it is within the robot work envelope.

Grippers vary from simple vise-like mechanisms to elaborate vacuum suction cups, welders, inflatable bladders, electromagnets etc. The tooling on the end of the robot arm is one of the critical factors to consider in the implementation of a robot task. If the task is simple, standard tooling may be used. For more complex jobs new designs may be needed. Typically, grippers are used for point-to-point tasks such as loading/unloading and palletizing. Since many different tasks are performed by robots, it is not surprising that there are many different requirements for gripper end effectors.
GRIPPER DESIGN

Gripper Requirements. Research is being carried out in the area of sensor development in the Department of Mechanical Engineering at Queen's University (2, 3, 4, 5) and, as part of this work, grippers are needed to test the viability of the sensors for industrial operations. This creates a host of problems in defining the type of gripper required for this type of operation. It was decided early on that some of the gripper requirements were:

1. Parts must be held without causing damage.
2. Gripper parts must be rigid.
3. Grippers must be able to apply a range of forces on a variety of parts.
4. The gripper fingers must permit installation of a variety of different sensors.
5. The gripper "fingers" should move with parallel motion thereby eliminating one potential unknown from the kinematic geometry.

Kinematic Gripper. A literature search indicated the possibility of manufacturing a parallel motion kinematic gripper. A kinematic, four-bar linkage was proposed by Chase et al (1) using a special software system they had devised for designing kinematic mechanisms. The feasibility of a four-bar linkage, for parallel motion, as discovered by Chase is shown in Figure 1. Chase went on to suggest the device shown in Figure 2. Although the kinematic four-bar linkage was conceived by Chase, the device was subsequently manufactured at Queen's and it is described in this paper. It seems to be the only one of its kind that has actually been built.

After considerable effort, a prototype of the linkage described by Chase was assembled as shown in Figure 3 (a). Further analysis and design produced the linkage shown in Figure 3 (b). The linkage shown produces parallel motion which was one of the requirements. The design also provided