VISION-GUIDED DYNAMIC PART PICKUP LEARNING ALGORITHM

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ABSTRACT

This paper addresses the problem of picking up moving objects in pseudo-random motion. There are many industrial tasks in which visual servoing is required to provide sophisticated guidance information for either the tracking or grasping of objects in motion. In the case of grasping, there will come a point at which the view of the object being tracked will become obscured by the actuating mechanism itself, whether the vision system is mounted on or off the actuation mechanism. Thus, it becomes necessary to predict the future state of an object that is desired to be grasped.

Figure 1 shows the relationship between a moving object and a gripper. Consider that the moving object is detected at time t_i and the robot is commanded to pick the object up at time $t_{i+1} = t_i + \Delta t$ where Δt is the time interval between sensing and pickup. In order to pickup the moving object, the robot controller must compute the joint rotations to move its end-effector from its initial viewing position to the grasping position. As shown in Fig. 1, the system uses a position-based vision system to determine the initial state of the object and a recursive learning algorithm to predict the pickup state.

Specifically, we present here a recursive learning system to guide an industrial robot to pick up moving objects from the surface of a vibratory feeder. The contributions of the paper are briefly summarized as follows: (1) The algorithm requires only an initial location and orientation of the moving object to predict the state of the object at the point of pickup. This overcomes a common vision problem; that is, the view of the object at the point of pickup often becomes obscured by the gripper itself. (2) For a given initial state of the object, only the robot response time is needed to command the robot to execute the pickup task, which can be determined off-line by training for a specified velocity. Thus, the technique introduced in this article can be readily implemented on an off-the-shelf industrial robot without special modification of its controller which is treated as a "black box". (3) The concept feasibility of the dynamic part pickup system has been experimentally demonstrated and evaluated on an industrial robot and a vibratory feeder in real time. The results provide significant insights to the other similar applications such as catching and hanging live birds on shackle line for poultry processing.

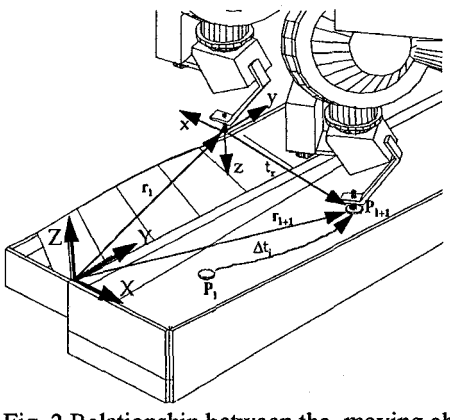

Fig. 2 Relationship between the moving object and gripper