

Vision Guided Manipulator for Optimal Dynamic Performance

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Abstract - This project develops an algorithm to optimize the dynamic performance of an industrial robot with aid of vision system technology. It consists of three major phases: (1) theoretical, simulation and practical of forward and inverse kinematics for FANUC LR Mate 200iB robot to determine their D-H parameters, (2) optimization of robot movements, and (3) implementation of practical tasks. The camera is used as a vision sensor to incorporate an intelligent algorithm for the recognition of coordinates of target objects' and to guide the robot to perform certain tasks. The optimization process involves the control of two parameters known as position (x) and speed (v) of the 3 main axes of the robot. Its forward and inverse kinematics problems will be simulated using Robotic tools of Matlab 7.0 and Roboguide V2.3.2. The simulation results will be compared with the real practical movements. This paper will describe the technique, calculation and method on how the first phase was done.

Index terms: Vision-Guided Manipulators, Optimal Control, Path-Finding, Image Processing, Dynamic Performance.

I. INTRODUCTION

Moving in an unknown environment is an experience for all animated systems. This is possible because the visual information data stream holds a large number of useful parameters that all these system interpret and translate into actions as well as into behaviors.

It is now well accepted that the use of vision systems coupled with a robot manipulator can considerably improve their robustness and efficiency and allow the realization of complex industrial tasks when a single robot manipulator is likely to fail. The concept of reconfigurable manipulators has been recently developed to facilitate the synthesis of manipulators structures to best suit specific tasks.

In this project, one of the sensors that are currently being used in controlling robot mechanism is vision. Optimal-based control strategies will be developed to perform manipulative actions. This vision guided robot could perform the tasks with improved efficiency using the optimal-based control strategies. The advantages of these optimal control strategies can be seen during performing the tasks with fewer movements of angles and improved time motion that result in more efficient usage of energy.

To find the optimal dynamic performance of a robot, it is important to know the architecture of its kinematics first. From forward or inverse kinematics analysis of that particular robot, we will obtain an exact position and orientation for each of its movements. This will help to find the most suitable position and orientation to achieve optimal performance. Figure 1 describe the overall diagram for the system.

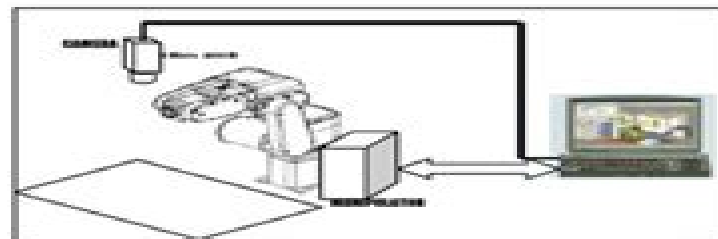


Fig. 1: Proposed vision guided manipulator's system

II. KINEMATIC ANALYSIS

To develop and demonstrate our approach in the real-world experiments, the articulated-arm robot with 6 d.o.f. FANUC LR Mate 200iB equipped with a parallel-jawed gripper have been used. So, the inverse and forward kinematics architecture for this robot must be identified first before studying the dynamic performance.

A. Forward Kinematics

Kinematics is the science of motion which treats motion without regard to the forces that cause it [1]. Here, a method to compute the position and orientation of the robot's end-effector relative to the base of the robot or we call it the forward kinematics, will be described.

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