

PNEUMATIC ROBOTIC ARM AND ITS CONTROLLING FOR AUTOMATION

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Abstract - Controlling of pneumatic robotic arm for automation is very important for material handling purpose. Automation of pneumatic arm is to be done between two machines namely extrusion and belt grinding machine. Pneumatic actuators have a number of advantages over electric motors, including strength-to-weight ratio, tunable compliance at the mechanism level, robustness, as well as price. The handling of materials and mechanisms to place of objects from lower plane to higher plane and are widely found in factories and industrial manufacturing. The designed processes are carried out based on integrated information of kinematics dynamics and structural analysis of the desired robot configuration as whole. The arm is actuated by two pneumatic artificial muscles, that expose a highly non-linear behavior. To enable a significant speed-up of the learning process, an empirical simulation is constructed, based on real robot observations.

Key Words: Pneumatic Robot Arm, Material Handling, cylinder, Controlling.

1. INTRODUCTION

India has started to decrease its population, leading many in the country to be concerned about its labour force shrinking. In various industrial fields, automation of the factories is one way to make up for reduced man power. Pneumatic systems are becoming increasingly popular due to their high speed and force capability, as well as relatively low price and overall robustness. From the perspective of bio-robotics, pneumatic actuators are further desirable because they have many of the essential properties of biological muscle at the mechanism level – which we believe is quite different from trying to re-create those properties using feedback control.

The highly nonlinear properties of pneumatic modeling and uncertainties of various parameters, the control problems become challenging for systems with high precision requirement on force and position. Various approaches have been proposed to cope with these problems. Early applications used a linearized state space model to develop an optimal regulator for a fixed operating point. Later, adaptive control was used for actuating an air power robot. To solve this problem, we need to focus on hardware and software. In terms of hardware, we have to develop end effectors that can grasp various things. In terms of software, we need to combine image-recognition techniques with feedback and sequence control techniques.

Material handling is a necessary and significant component of any productive activity. The highly dynamic pneumatic arm model can be easily set at intermediate positions by regulating the pressure using the flow control valve. It can be used in loading and unloading of goods in a shipping harbour as the movement of goods is done from lower plane to higher plane. We previously developed a pneumatic robot arm driven by pneumatic cylinders as a versatile end effector. This arm consists of a pneumatic hand and pneumatic end effector, it can grasp objects that have different shapes and mechanical characteristics.

The system is better at major company steps in robot arm design are kinematics design, dynamics design, thermal design and stiffness design. Structural analysis of models is done in all industries. It might be difficult to the worker whose pick and best something that can place (square) itself so affect mobile robots widely used are in many field of applications such have service (office), military task, hospitals, acidic environment and agriculture (farming) and working in hazardous environment where explosions are likely; industries where it is highly suitable are mining, chemical, petroleum and painting industries.

The muscle radius increases and together with radial expansion, the muscle contracts axially and exerts a pulling force. Also, the generative force of a pneumatic actuator depends on the air pressure and shrinkage ratio, and these pneumatic actuators are driven by low pressure. The main objective of a material handling system is to reduce the unit cost of production. Otherwise, they are often avoided because they exhibit high nonlinearity and are hence difficult to control. But the advent of sophisticated control systems and algorithm for pneumatic servo system in the recent years shifted the paradigm in pneumatic technologies. It is now possible to control pneumatic servo system just like electro servo system.

2. SYSTEM OVERVIEW

2.1 Pneumatic Arm

A Robotic Arm can be compared to a human hand. It has a free rotating joint (rotation) and a translational joint (displacement) for the movement of the arm. This arm movement is usually driven by an electric driver (motor) or a pneumatic and a hydraulic system (pistons). These actuators are controlled by a microcontroller (CPU), usually programmable and made to perform a set of sequential

tasks. Most of these robotic arms are designed to be used for industrial purposes for fast and reliable performance, helping for mass productions. This robot has five axes which are driven by DC motors (24Vdc) and it is made to be controlled manually by using sets of two potentiometers for each joint. To control a single joint, two potentiometers are used connected to each other in a feedback amplifier circuit. The comparator circuit compares the voltage between the axis potentiometer and the driver potentiometer, and it drives the motor in two directions depending on the voltage between these two potentiometers.



Figure 1: Pneumatic Robotic Arm design

2.2 Components of Pneumatic Arm

A. Pneumatic cylinder

This is mechanical device which use the power of compressed gas to produce a force in a reciprocating linear motion. Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement. For example, in the mechanical puppets of the Disney Tiki Room, pneumatics are used to prevent fluid from dripping onto people below the puppets.

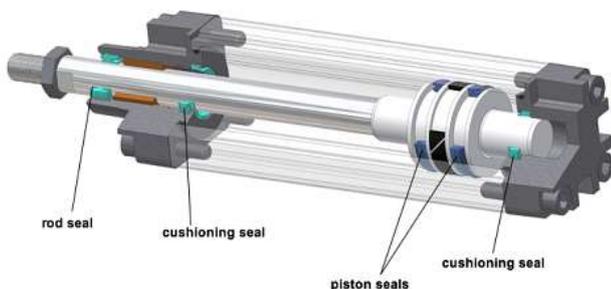


Figure 2: Pneumatic Cylinder

B. Flow control valves

A pneumatic system, energy that will be used by the system and transmitted through the system is stored as

potential energy in an air receiver tank in the form of compressed air. A pressure regulator is positioned after a receiver tank and is used to position out this stored energy to each leg of the circuit. A pressure regulator is a normally open valve. With a regulator positioned after a receiver tank, air from the receiver can expand through the valve to a point downstream.

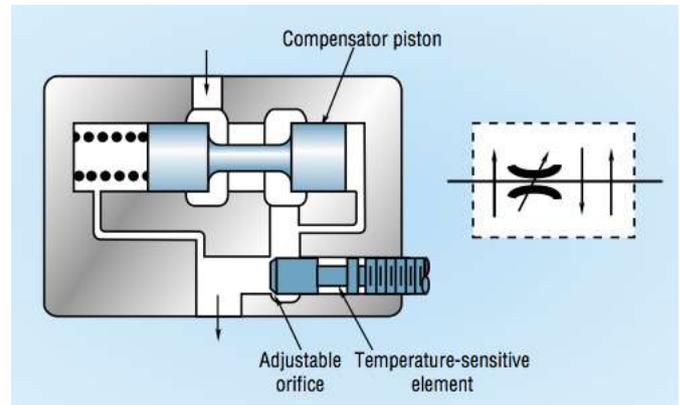


Figure 3: Flow Control Valves

C. DC Motor Controller

A motor controller is a device or a group of devices that serves to govern in some predetermined manner the performance of an electric motor. A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and faults.



Figure 4: Pneumatic Motor

3. WORKING PRINCIPLE

3.1 Gripper Design

This section includes the design and construction phase of the gripper. All the necessary design processes for a complete product are included in this part. As compared to real a design process in a real working life, this gripper design also includes all the essentials theoretical aspects of a product development.

Gripper Design Figure 5 below shows the typical robotics gripper. The following pictures show the mechanical grippers for a robotic arm. All of these mechanical grippers use the linear actuator and linear actuator can be easily controlled by the DC motor. The main aim to use the DC motor in the gripper is to make all the functions controlled by electricity. Using an extra pneumatic or hydraulic system for a gripper adds more complication and expenses. All the 3D modes of the grippers are designed using Pro E. and among all of this gripper, only one of these grippers is made finalized. Figure 5 below shows the typical robotics gripper.

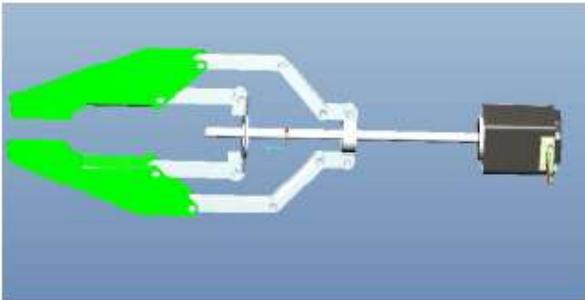


Figure 5: Robotic Gripper

3.2 Pressure Control Valve

Pneumatic valves circulate air throughout a larger pneumatic system by either allowing or inhibiting the flow of pressurized air, whose force is then used to power a device. Additionally, because they can move air in a variety of ways they can suit a variety of applications. Aside from the commonly used directional control valves, there are valves that are designed to serve more specific purposes, such as pressure regulator, venting-type regulator valves, and needle valves. Pressure and venting-type valves both help control pressure, whereas needle valves help control the flow within a pneumatic system.



Figure 6: Control Valve

4. CONCLUSION

In this paper, the controlling of pneumatic arm for automation is studied with economic and effective considerations. It is controlled by manually flow control and direction control valves. Robotic arm can reduce the human efforts by automatic handing of material, an automatic, servo controlled, freely programmable, multipurpose manipulator, with several areas for the handling of work pieces, tools or special devices. The gripper is also a pneumatic actuator which holds objects which are rectangular in shape.

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