"A Review on Design and Analysis of Single Arm Robot

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Abstract— Robot is a machine to execute different task repeatedly with high precision. Thereby many functions like collecting information and studies about the hazardous sites which is too risky to send human inside. Robots are used to reduce the human interference nearly 50 percent. Robots are used in different types like fire fighting robot, metal detecting robot, etc. Robot manufacturers are today experiencing ever increasing competition in a global market. For many of the robot manufacturers' customers, a key component in their strategy for greater efficiency has been robot automation. This is not case for the robot manufacturers themselves, who traditionally have little in-house production and an assembly process where merely marginal savings can be made through robot automation. Another way to improve the odds of being one of the fittest in this struggle for survival is instead to speed up the time to market for new products by shortening lead times in the development process this should of course be achieved without lowering any requirements with regard to quality and performance. The main objective of the project is to design and analysis of single arm robot for 250 grams payload. The corresponding deflections, stresses and strains for that load will be find out by using the method of finite element analysis (FEA).

Key words: Robotic Arm, Beam Specifications, Control System, FEA

I. INTRODUCTION

A robotic arm is a robotic manipulator, usually programmable, with similar functions to a human arm. The links of such a manipulator are connected by joints allowing either rotational motion or translational displacement. The links of the manipulator can be considered to form a kinematic chainman robot may be designed to perform any desired task such as welding, gripping, spinning etc., depending on the application. For example robot arms in automotive assembly lines perform a variety of tasks such as welding and parts rotation and placement during assembly. A rotation of 99 degrees is given to the robot arm in a minimum time (.02seconds) by supplying power to the robot arm using a switch. Further the arm will settle down with critical damping to an angle of 90degrees. The FE modal analysis has been performed for the robotic arm to find the natural frequency. Transient analysis is performed to note the displacement, velocity and accelerations during its Motion. However, the use of feedback can lead to an unstable system whose output may oscillate or even go to infinity with a small input signal. Stability determination is therefore an important design consideration. One specification for absolute stability requires that the poles of the transfer function must be in the left half of the s-plane. Absolute stability, often specified in the frequency domain, is essential and necessary but not sufficient.

Frequency domain specifications relating to relative system stability may also be given. For relative stability, a certain phase margin and gain margin may be specified to ensure that the system will remain stable although some parameters change due to temperature changes, aging or other environmental changes. If a system is stable, then other performance criteria, specified in either the time or frequency domain, may be considered to meet the performance requirements. Short-term, or transient, response specifications such as rise-time or percent overshoot to a unit step function input may be given. Fortunately, the advance control calculation can be solved with the help of using MATLAB software. In industrial automation the control of motion is a fundamental concern. Putting an object in the correct place with the right amount of force and torque at the right time is essential for efficient manufacturing operation. Feedback comparison of the target and actual positions is done in motion control system. This comparison generates an error signal that may be used to correct the system, thus yielding repeatable and accurate results. The goal is to design a compensation strategy so that a voltage of 0 to 10 volts corresponds linearly of an angle of 0 degrees to an angle of 90 degrees.

II. LITERATURE REVIEW

K. MANOJ KUMAR & CH. SAMBAIAH: In this paper the Motion control is one of the technological foundations of industrial automation. Putting an object in the correct place with the right amount of force and torque at the right time is essential for efficient manufacturing operation. In the present work modeling of control system for motorized robot arm with a single degree of freedom is done. The results of the control system are also described. The control algorithm was developed by MATLAB software which is widely used in controlling application. In this system the DC motor moves the robot arm to the desired angular position in accordance with the input given.[1]

GABRIEL MUNTEANU, ADRIAN GHIORG-HE: An important characteristic for the field of industrial robotics is the positioning precision of end effectors. Due to the progress of the computer technologies and control systems, the accuracy has significantly improved in the last years. Still, there is a continuous need for machines to provide higher accuracy mechanisms and kinematic chains or to adjust the systems already built in order to adequate it to reach to a better precision of the tasks. The current paper shows the results of a comprehensive analysis applied for RRR-RR robotic system already build including two versions of static analysis and modal analysis, using the modern virtual instruments. The main stages pursued was: design of the mechanisms and kinematic chains for each rotation joint, in accordance with the real robot, modelling of the connections and the mesh for each element and surface, simulation and model analysis using FEM

specialized instruments. A final indication about the characteristics to improve is presented. [2]

ADRIAN GHIORGHE: The current paper shows a methodology to determine the optimum values for the design parameters considering the criteria of reducing the material used to build the structure of industrial robot, using a structural optimization and topology algorithm. This analysis is based on the finite element method (FEM) and consists in completion of the design model using the dimensional data as parametric design variables to which restriction conditions have been applied in order to achieve the object function. A recurrent FEM analysis using different parameters for the design variables was applied in order to assess an optimum composition of the object function. [3]

DR. AHMED ABDUL HUSSAIN ALI, DLER OBED RAMADHAN: The stresses and deflections in robot arm was analyzed using ANSYS software package. Industrial robot analyzed in this work consists of three arms that have 2-DOF. The analysis of each arm had been made separately. The maximum stress and deflection have been analyzed for a static applied at one end of the arm while has the other end fixed. Links of various cross-sections having same masses, length, and material properties to make a choice of the shape that gives a high stiffness to weight ratio have been examined. After specifying the best section for the arms of the robot an optimization process began to determine the dimensions of the arms sections which give the least deformation this had been done by the aid of a program build up by using the MATHCAD software package. In the beginning the program finds the optimum section in which the stress in the members not exceeds the allowable stress and finds the total weight of the robot after that the program begins to change the dimensions to satisfy the condition of minimum deflection of the whole robot after that the program estimates the best choices of the dimension for each section that gives the minimum weight and deflection. [4]

III. Formulation of Design Problem

- Self-weight of robotic arm reduces the weight lift capacity of the robot
- Minirobot of Mtabindia weight 7 to 8 Kg. has payload capacity of 250grams
- As total power lift arm weights and payload, decreasing weight of arms can increase the load carrying capacity of the robot

IV. Objectives

The main objective in completing the project is to achieve the standards that have been set. And the optimization is to minimize the mass of the robotic arm. In this formulation, we minimize only the mass of the arms, while the mass of the drive system remains constant.

Therefore, the optimization task is to find the lightest structure for all five of that fulfill all constraints associated with the motors and gearboxes

V. Research Methodology

- Literature Review.
- Data accumulation.
- CAD Model generation
- Finite element model generation
- Stress analysis of Problem.
- Result and discussion.
- Conclusion.

VI. Conclusions

This project will help engineers to find the lightest combination of structure and motors by optimizing the mass of the robotic arm.

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