INTERNATIONAL JOURNAL OF TECHNO-ENGINEERING
IJTE

ISSN: 2057-5688

COMPUTER AIDED ROBOT

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***Abstract**: 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 transnational displacement. The links of the manipulator can be considered to form a kinematic chairman 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 mine is essential but not necessary but sufficient.*

I. INTRODUCTION

A robotic arm is a robot manipulator, usually programmable,with similar functions to a human arm. The links of such manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) transnational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain.The business end of the kinematic chain of the manipulators called the end effector and it is analogous to the human

hand. The end effector can be designed to perform any desired task such as welding, gripping, spinning etc.,depending on the application. The robot arms can be autonomous or controlled manually and can be used to perform a variety of tasks with great accuracy. The robotic-arm can be fixed or mobile (i.e. wheeled) and can be designed for industrial or home applications.

This report deals with a robotic arm whose objective is to imitate the movements of a human arm using accelerometer as sensors for the data acquisition of the natural arm movements. This method of control allows greater flexibility in controlling the robotic arm rather than

using a controller where each actuator is controlled separately. The processing unit takes care of each actuator's control signal according to the inputs from accelerometer, in order to replicate the movements of the human arm. the block diagram representation of the system to be designed and implemented.

ROBOTIC ARM IN DAILY LIFE

"Can you hold this for me?", "Please glue those parts together", "Pass me that salt", "Please solder these wires together", and "Where is the remote?" Such sentences are commonly heard in living and working circumstances. However, the word with is becoming more and more expensive in a society where time means money. This problem is part of a trend in technology to make us more separate from each other even as it makes us more independent. Compounding

this trend is robotics; it is one of the technologies that will soon change our way of living (see

Robotic manipulators and robotic arms were the very first robots to be used in industry (they have been in use since the 1960s

Although the robotic arm was designed for manufacturing and production processes, it has long been used for other purposes by researchers. A large number of studies have focused on robots for helping individuals with physical challenges, for example, the desktop robotic system by Hummel

With the continued progress in computing power, computer vision, and advanced sensors, research have started to focus on uses of robotic arms in daily life and work environments in project such as Care-O-bot and the recent mobile manipulator robot PR2 from Willow Garage

Our concern here is how robotics arms can be used in daily life by healthy individual. As such, we need more ideas and individual perceptions about robotic arms if they are to become a part of our lives. The studies from Rayet al.

Dautenhahn et al.and Khan established M. Wongphati and Y. Matsuda are with Graduate School of Science and Technology, Keio University, Japan {mahisorn,yushi}@ayu.ics.keio.ac.jp H. Osawa and M. Imai are with Faculty of Science and Technology, Keion University, Japan, Image courtesy of PegaSanoamuang Imaginative drawing showing a robotic arm helping a busy architect to cut a 3D paper model a standard guideline for describing people's expectations, perceptions, and attitudes toward robotic system in daily life. Their studies utilized questionnaires that were conducted during a public event an interview before and after a real robot experiment and a handout survey for collecting data from various groups of participants. Some of their findings are as follows

• People generally have a very positive idea about robots in daily life.

• They expect a robot to help in various tasks, but especially as say a butler robot rather than as a friend or companion.

• Household tasks such as cleaning, home security, and laundry are preferred over personal or life-related tasks such as child/pet care, personal belongings tidying, and cooking.

• Human-like designs are not preferable. Rather, modest size robots (30-50 cm in diameter and 100 - 150 in height) with personalized designs are preferred. These studies, however, only addressed the general form of a robot; participants imagined robots as those from fiction or as a humanoid. Their results thus might not reflect all the possible outcomes if the same questions were asked in regard to a specific type of robot. To the best of our knowledge,very few studies have attempted to address issues affecting the use of robotic arms in daily life for users without physical challenges. Exceptions, however, can be found in certain research topics such as cooperative assembly and working processes and some of the robots mentioned in the highly cited surveys In this paper, we present our survey study that collected ideas and perceptions of robotic arms as parts of daily living and working circumstances. The study focused on what tasks and places users would want a robotic arm to perform for delay manufactured and sold all over the word. Hundreds of kinds of arms are available through a multitude of companies, where these arms are primarily developed assist in industrial production and assembly lines. By installing different tools on their standard wrist interfaces, these arms are being used in many applications that require

great precision and repeatability (e.g. welding, manipulation ,spraying).

Most of the research on improving the design and performance of the mechanical and control systems of the commercially available arms is carried out by the robotic companies and their collaborating labs. The reliability and robustness of these arms make them an important product

and an invaluable test bed for the research units investigating novel applications and intelligent control designs. Therefore, from the perspective of a researcher, choosing a suitable robot arm and its controller is a crucial research decision. This paper is the product of almost one year of extensive market research (through internet and active communication with robot manufacturing companies) and compiles the collected information in the form of a survey of the state of

the art in commercially available robotic arms .Depending on their target market, different companies build robotic arms with different functionalities and performance. Based on the technical specifications, these arms can be sold from relatively low prices to some

surprisingly high ones. Especially for the institutes looking for robotic arms, different research objectives will result in completely different choices. Besides considering the standard parameters of arms – degrees of freedom (DOF), payload, repeatability, weight, workspace requirement etc. – attention also needs to be paid to the controller, flexibility to

add new sensing devices, possibility to integrate new and existing software, availability of the software simulator, after sales service etc. For future scalability, it is extremely important to take these parameters into consideration early on, before a final purchase decision is made.

This survey enumerates and introduces robotic arms that are suitable for open research problems on intelligent manipulation and control. The surveyed arms have been categorized into four classes:

1) Cheap educational arms: These arms are relatively cheap, with a price range between 300 and 500 Euros.Equipped with a simple controller and cheap motors, these arms are not very precise and their functionality limited. However, such arms will suit educators, hobbyists and

researchers if they are investigating simple joint control and manipulation tasks. For the website links to some of companies that offer such arms please see.

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.

GABRIEL MUNTEANU, ADRIAN GHIORGHE : An important characteristic for the field of industrial robotics is the positioning precision of end effector. 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.

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.

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.

III SOFTWARE OVERVIEW

CATIA-V5 is the industry's DE factor standard 3D mechanical design suit. It is the world's leading **CAD/CAM /CAE** software, gives a broad range of integrated solutions to cover all aspects of product design and manufacturing. Much of its success can be attributed to its technology which spurs its customer's to more quickly and consistently innovate a new robust, parametric, feature based model. Because that CATIA-V5 is unmatched in this field, in all processes, in all countries, in all kind of companies along the supply chains. Catia-v5 is also the perfect solution for the manufacturing enterprise, with associative applications, robust responsiveness and web connectivity that make it the ideal flexible engineering solution to accelerate innovations. Catia-v5 provides easy to use solution tailored to the needs of small medium sized enterprises as well as large industrial corporations in all industries, consumer goods, fabrications and assembly. Electrical and electronics goods, automotive, aerospace, shipbuilding and plant design. It is user friendly solid and surface modeling can be done easily.

Advantages of CATIA-V5:

- It is much faster and more accurate.
- Once a design is completed. 2D and 3D views are readily obtainable
- The ability to changes in late design process is possible.
- It is user friendly both solid and surface modeling can be done.
- It provides a greater flexibility for change. For example if we like to change the dimensions of our model, all the related dimensions in design assembly, manufacturing etc. will automatically change.
- It provides clear 3D models, which are easy to visualize and understand.
- CATIA provides easy assembly of the individual parts or models created it also decreases the time required for the assembly to a large extent.

MODELING SOFTWARE:

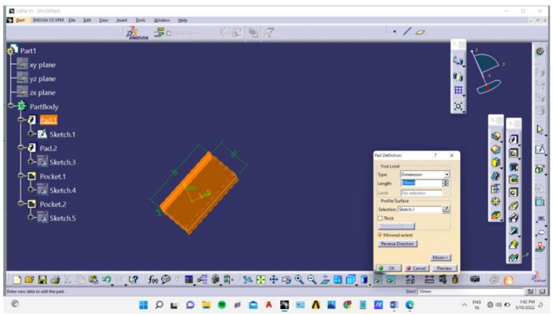
CatiaV5 R15 is an interactive Computer- Aided Design and Computer Aided Manufacturing system. The CAD functions automate the normal engineering, design and drafting capabilities found in today's manufacturing companies. The CAM functions provide NC programming for modern machine tools using the CatiaV5 R15 design model to describe the finished part. CatiaV5 R15 functions are divided into "applications" of common capabilities. These applications are

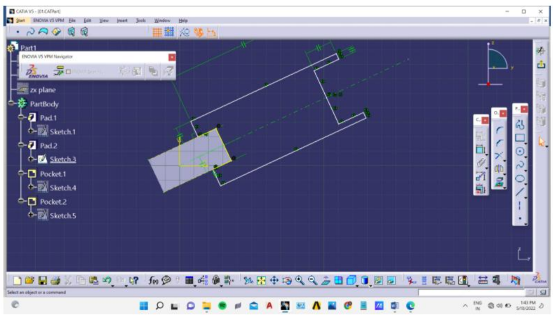
ISSN: 2057-5688

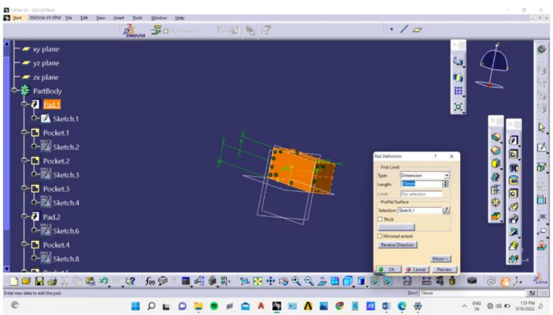
supported by a prerequisite application called “CatiaV5 R15 Gateway”.

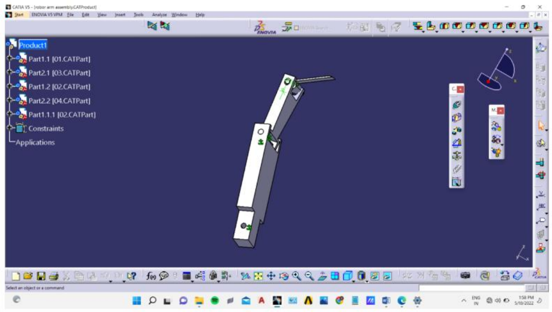
CatiaV5R15 is fully three dimensional, double precision system that allows to accurately describing almost any geometric shape. By combining these shapes, one can design, analyze, and create drawings of products.

IV DESIGEN





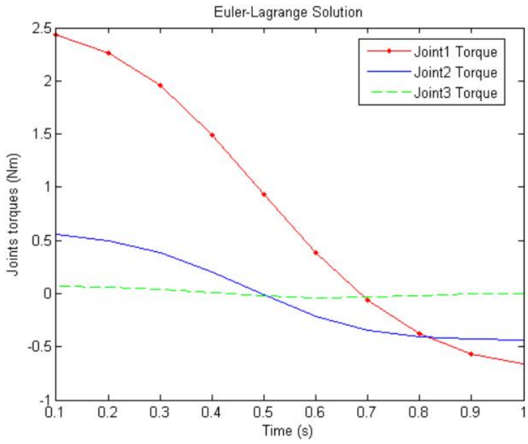




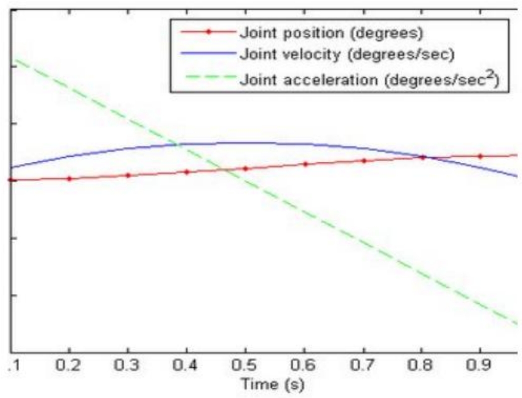
V Result:

The dynamic equations of motion provide the basis for a number of computational algorithms that are useful in mechanical design, control, and simulation. In inverse dynamics, the required joint actuator torques/forces are computed for a given a trajectory. Inverse dynamics is used in feed forward control. The joint space inertia (mass) matrix is used in analysis, in feedback control to linear the dynamics, and is an integral part of many forward dynamics formulation. Figures 5 and 6 shows the joint torques obtained from simulations from equations of motion obtained from derivation and by using software Robt Analyzer respectively.

ISSN: 2057-5688



Joint Torques by Euler-Lagrange Equations derived



Joint Trajectories

Kinematic-ally redundant manipulators are designed to increase the manipulable and dexterity of a robotic manipulator and also to incorporate the joint failure tolerance. The design of the control system of any robotic system requires the knowledge of its dynamic properties and the mathematical equation of motion. The given study has aimed to derive a complex mathematical equation of the three degree of freedom robotic arm. This mathematical equation is useful in the design of its control system like the computed torque control and other such techniques. The analytical results are in quite agreement with the numerical ones. The Analyzer© software uses the Decoupled Natural Orthogonal Complement (DeNOC) Matrices based on recursive formulation. The joint torques are curves quite intuitive and since the gravity was taken into account the maximum values of torque at initial was considered. The joint torques values decrease to zero and then a negative torque is required to bring the assembly to rest.

VI CONCLUSIONS

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

A concept for a fully modular and highly redundant robotic manipulator for space application and transfer potential for terrestrial use is presented within this paper. The applicability of the multifunctional space interface issue is shown. Solutions for the inverse kinematics and control of a modular robot are presented. The feasibility of the concept is proven by one demonstrator with numerous DOF at the magnitude of a Cube Sat with focus on kinematics and control. Furthermore, an on-ground demonstrator of larger magnitude with 3 DOF is designed to proof the potential for applications.

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