Optimal Path Deviation through NX Software of Industrial Robotic Arm

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Abstract— The aim of the project is to study the analysis of industrial robot. The robot used is a pick up and drop industrial robotic arm. The software used is NX NAXTRAN 9.0 as it gives accurate results and is advanced than other software's. The components of the robotic arm have been designed and assembled in NX Software along with the motion and dynamic analysis. The motion analysis includes the following parameters like displacement, velocity and acceleration. The dynamic analysis includes the parameters like force and torque. The optimum path for picking an object and dropping it after overcoming an obstacle by the arm for the given set of conditions has been derived.

Key words: NAXTRAN, Optimum Path, Motion Analysis, Dynamic Analysis

I. INTRODUCTION

A robotic arm is a type of mechanical arm, usually programmable with similar functions to a human arm. The arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand. The robotic arm is used in industries for various purposes such as transporting, material handling and various other fields and is a vital part in today's technology.

II. LITERATURE SURVEY

A. Dynamic analysis of flexible manipulators

In this paper a survey of the literature related to dynamic analyses of flexible robotic manipulators has been carried out. Both link and joint flexibility are considered in this work and an effort has been made to critically examine the methods used in these analyses, their advantages and shortcomings and possible extension of these methods to be applied to a general class of problems. Papers are classified according to modeling, control and experimental studies. In case of modeling they are subdivided according to the method of analysis and number of links involved in the analysis. An effort has been made to include the works of a huge variety of researchers working in this field and a total of 433 papers created in the years 1974–2005 have been reviewed in this work.

B. Dynamic analysis and intelligent control techniques for flexible manipulators

This paper reviews literature on dynamic analysis and intelligent control techniques for flexible robot manipulators. First, a comparative dynamic analysis of flexible manipulators was presented and then control strategies were categorized and studied. Fuzzy logic, neural network, and genetic algorithm approaches were introduced and a range of contributions of such methods in flexible robot control were presented. A total of 115 papers were surveyed in this research, covering a sufficient depth in assessment of dynamic and control of flexible manipulator systems for the time span of 1970–2013.

III. METHODOLOGY

Flow Diagram-The steps in which the analysis has been carried out is.

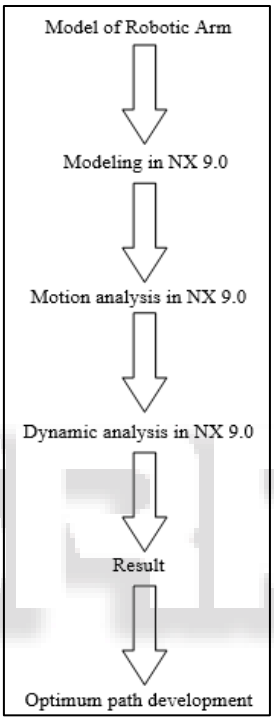

Fig. 1: Flow graph

IV. REVERSE ENGINEERING

Reverse engineering, also called back engineering, is the processes of extracting knowledge or design information from anything man-made and reproducing it or reproducing anything based on the extracted information. The process often involves disassembling something (a mechanical device, electronic component, computer program, or biological, chemical, or organic matter) and analyzing its components and workings in detail. The measurements for the arm have been taken through various instruments such as the Vernier caliper and screw gauge. By drafting and reverse engineering the robotic arm is converted into a 3 dimensional model.

V. MOTION SIMULATION

Most of the joints of the robotic arm are revolute in nature that is they rotate about fixed, their motion can be controlled and are not allowed to rotate freely. The revolute joints are between

- The base body and connecting plate
- The connecting plate and main body

- The main body and the gripper plate holder
- The gripper and the gripper plate

The second type of joint use in cylindrical in nature that is the motion is free and is not constrained. The joint is between the shaft and the base of the robot.

The motion analysis includes three parameters for which the analysis is done.

- Displacement
- Velocity
- Acceleration

The components are converted into the following for motion analysis

- Joint
- Link
- Driver

The components of the arm have been given mass and inertia to make the results obtained from the simulation more accurate and realistic.

VI. SCRIPTING

A scripting or script language is a programming language that supports scripts; programs written for a special run-time environment that automate the execution of tasks that could alternatively be executed one-by-one by a human operator.

- However, in NX this was not possible so the method used for performing two simultaneous functions was STEP FUNCTION.
- The step function of NX 9.0 is shown below.

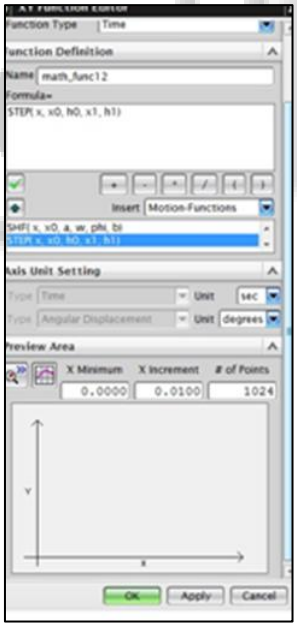

Fig. 2: The step function of NX 9.0

- The step function is subpart of the MATH FUNCTION.
- The symbols denote
  1) X- Function for which step function works e.g. TIME
  2) X0-Time for which it needs to run
  3) H0-Velocity with which it needs to run
  4) X1-Time after finishing of X0 it needs to run
  5) H1-Velocity for which it needs to run after completion of H0
- The step function works like
  1) A function needs to be defined according to which the step function will work for example TIME.
  2) The next parameter that needs to be defined is time in seconds for how much time the body needs to move.
  3) The next parameter is the velocity i.e. with what velocity will the body move.
  4) The next function is again the time for which the body needs to move but it only moves after the first time function has been completed.
  5) The next function is again velocity, with how much speed it needs to move.
- The axial setting defines that how the body will move. It will either move in Degree per second or Millimeter per second.
- In the preview area the preview of the motion can be obtained.
- The industrial robot required to perform more than one motion so two step functions were used to give the simultaneous motions to get the required result.

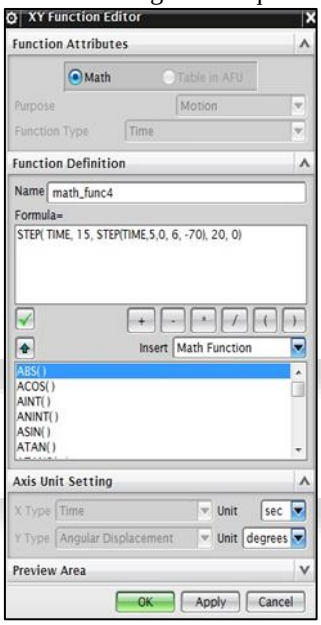

Fig. 3: The step function of NX 9.0

- The Multiple Step Function has the same principle.
- The above diagram has the following working as in the 15 seconds the interval for which the first 5seconds the displacement is 0 and for the next 6 seconds the displacement is -70 and all of this happens in 15 seconds and after this for next 20 seconds the displacement is 0.

VII. RESULTS AND DISCUSSIONS

- The study of the industrial robot has been done in NAXTRAN NX9.0 in motion analysis.
- The study includes the motion analysis and dynamic analysis of various components of the industrial robot.
- The parameters of motion analysis like displacement, velocity and acceleration have been derived and the graphs have been discussed.
- Similarly the parameters of the dynamic analysis like force and torque have been derived and graphs have been discussed.
- The graphs show the variation in parameters that are not visible to the naked eye but at the microscopic level how much effect they cause.

- The optimum path of the industrial robot is generated showing that an object can be placed from one place to another in shorter period of time if motors are used.
- This gives us lesser time output for maximum path covered.
- The industrial robot if working on a single motor takes a lot of time so to reduce the effective cost and to find the optimal time the study has been done in NAXTRAN NX9.0.
- The robot path has to be set in such a way that the time taken is least and the path is made shortest.

VIII. CONCLUSION AND SUGGESTIONS

- Initially the robot works on a single motor due to which there is one motion at a time and hence the object is picked up first and then moved and then dropped after overcoming the obstacle.

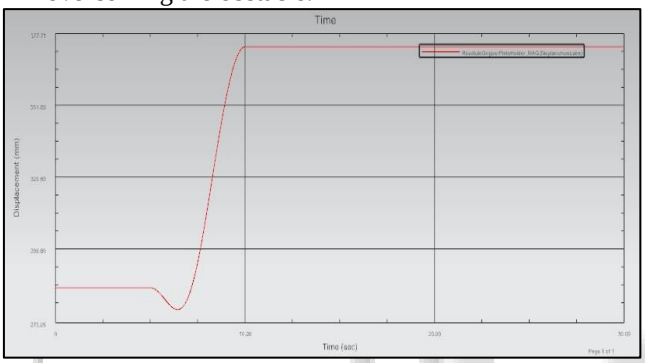

Fig. 4: Normal path graph for gripper plate holder

- As it can be seen in the graph the displacement occurs over a period of 10 seconds and then the lift becomes constant.
- When the single motor is used at a time the time consumption is more as first the plate lifts the object then it overcomes the obstacle and then it drops the object.

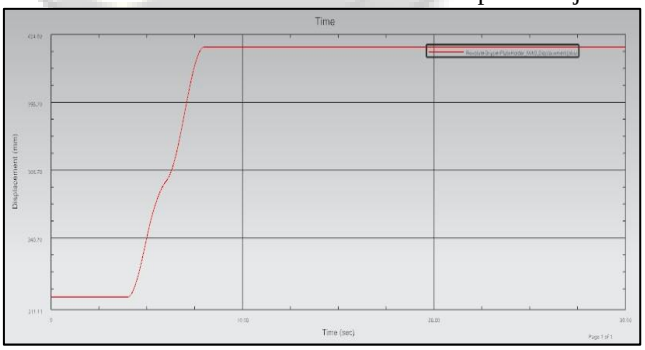

Fig. 5: Optimum path for gripper plate holder

- In optimum path generation the 2 motors are used simultaneously to reduce the time and the path of the robot.
- When 2 motors are used at the same time, the plate lifts the object and at the same time the second motor helps in overcoming the obstacle.
- As the obstacle is being overcome the first motor starts again bringing the object down to reduce its path.
- The time interval as can be seen is less than 10 seconds and the lift is constant.
- The graph shows that the time can be saved if more motors can be used effectively to reduce the path and thus helpful in saving time of industries.

IX. FUTURE WORK

- The vibrations which occur in gripper when it holds on to the object at microscopic level can be reduced by trying to reduce the forces acting and making the vibrations as less as possible.
- The forces can't be made constant but they can be taken to such a level so that the varying forces acting are at a minimum.
- The optimal path can be further reduced as more motors and higher speed can be used to reduce time for the same path.

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