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Design and Simulation of Kuka Robotic Arm using CATIA and Power MILL Software

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Abstract:
In this fast growing industrial age every company needs rapid manufacturing to cope up with the customer's requirements. Every industrialist cannot afford to transform his unit from manual to semi automatic or fully automatic as automation is not that cheap in India. The basic objective of my project is to develop a versatile and low cost robotic arm which can be utilized in any industry to eliminate this problem. The robotic arm so designed can be used in number of application by changing the program of controller and the structure is designed in such a way that it is capable to work under all type of conditions. The robotic arm will be used mainly in the machining processes like drilling and boring etc. KUKA configuration for robotic arm which is cylindrical and have two parallel joints will be designed and simulated using CATIA which is latest design software for assembly and simulation of machine parts. Further simulation is carried out in PowerMILL which simulates the tool path to be traced by arm during machining process. The simulation parameters are shown graphically in form of time graphs

Keywords: CATIA, KUKA, Power MILL, Robotic Arm and Simulation

I. INTRODUCTION

A robotic arm is a type of mechanical arm, usually programmable, with functions homologous to a human arm. The most common manufacturing robot is the robotic arm. A typical robotic arm is made up of seven metal segments, joined by six joints. The computer controls the robot by rotating individual step motors connected to each joint. An industrial robotic arm is used for welding, painting, assembly, pick and place for printed circuit boards, packaging and labeling, palletizing, product inspection, and testing; all accomplished with high endurance, speed, and precision. KUKA configuration for robotic arm which is cylindrical and have two parallel joints will be designed and simulated using CATIA which is latest design software for assembly and simulation of machine parts.

KUKA Robotic arm: CATIA offers a solution to shape design, styling, surfacing workflow and visualization to create, modify, and validate complex innovative shapes. CATIA supports multiple stages of product design whether started from scratch or from 2D sketches (blueprints).CATIA enables the creation of 3D parts, from 3D sketches, sheet metal, composites and molded forged or tooling parts up to the definition of mechanical assemblies. The software provides advanced technologies for mechanical surfacing. It provides tools to complete product definition, including functional tolerances as well as kinematics definition. It also provides a wide range of applications for tooling design, for both generic tooling and mold & die. In the case of Aerospace engineering an additional module named the aerospace sheet metal design offers the user combine the capabilities of generative sheet metal design and generative surface design.

II. LITERATURE REVIEW

This paper deals with designing a Robotic arm in the national Science Foundation Engineering Senior Design Projects for the person having some disability in arms and legs. Its name was 'Clutching and Gripping Device' developed by Arizona State University [1].The similar Kind of project was made by the University of Massachusetts named as ' Assistive Reach Mechanism'. This device was having capacity to reach objects up to four feet from it and lifts five pounds of load. Multi-DOF Robotic Assembly for Press Shops is the example of robotic arm. This project deals with the design, fabrication and control or monitoring of a robotic arm used for loading and unloading the metal sheets into a press. It consists of two stepper motors, out of which one control the motion of the arm and other the orientation of the wrist.[2].A robotics arm operating on Haptic technology having four degrees of freedom is unique concept on which these expert perform their research. It is designed for picking up certain object of specific weight and placing at desired location is presented in this project .The remote controller, controls the movement of robotic arm. The robotic arm is made of Polycarbonate material. The points having certain angle of rotation are fitted with potentiometer. The microcontroller named Arduino duenmlanove consist of ATemega- 328 as a processor is used to read potentiometer input signal in electrical form and convert it into digital pulse form (PWM), which drives the servomotors or the arm.[3]. The new concept of designing a robotic arm with additive technology is explained in this paper. There objective was to design and built a customized, lightweight and low cost robot, capable to fulfill many industrial working tasks such as palletizing mobile telephone covers.[4]. Solid works software were used to designing and optimizing the robotic structure. Articulated robotic arm is used for handling and separating waste in waste management facility. This project focuses on thorough analysis on the design project of robotic arm for waste management application. The CAD software, Solid Works is used to model the detail design of the robotic arm, and to simulate the motion of the device. [5].This paper proposes a study on the workspace of the guiding device mechanism of a parallel topology robot is presented. The kinematical scheme and the

geometrical model of the guiding device mechanism of the parallel topology. The lengths of binary links between the platforms determine the shape and the volume of the parallel robot's workspace; different boundaries of the workspace are presented. Thus, variation of the workspace in both volume and shape is studied, depending on the binary link lengths, using for modeling and simulation Solid Works software.[6] A kinematically redundant manipulator is a robotic arm posses extra degree of freedom(DOF) than those required to establish an arbitrary position and orientation of the end-effector. A redundant manipulator offer several potential advantages over a non-redundant manipulator[7].Development of versatile robotic hand just like artificial arm or humanoid robot is need of today. In this paper, Omni-directional bending mechanism called "double-screw-drive mechanism" was applied to drive a robotic hand. Robotic hand having three fingers as gripping part was built, and experimentation was carried out, in which each finger was controlled so as to track the elliptical orbit.[8]The robotic arm driven by pneumatic actuator for material handling was developed by this team. It consists of pneumatic hand and pneumatic wrist. The hand looks like human hand and able to grasp objects that have different shapes and mechanical characteristics. In this research, experimental models of the drive system of the pneumatic robot wrist have been constructed. [9] The robot arm was designed with four degrees of freedom and does simple tasks, such as light weight material handling, which will be integrated into a mobile platform that serves as an assistant for industrial workforce. Different servo motors with variable capacities are implemented to operate various links. For controlling the robot they used **Lab view**, which performs inverse kinematic calculations and communicates the proper angles serially to microcontroller that drives the servo motors with the capability of modifying position, speed and acceleration.[10].CATIA offers a solution to shape design, styling, surfacing workflow and visualization to create, modify, and validate complex innovative shapes and offer the user combine the capabilities of generative sheet metal design and generative surface design [11]

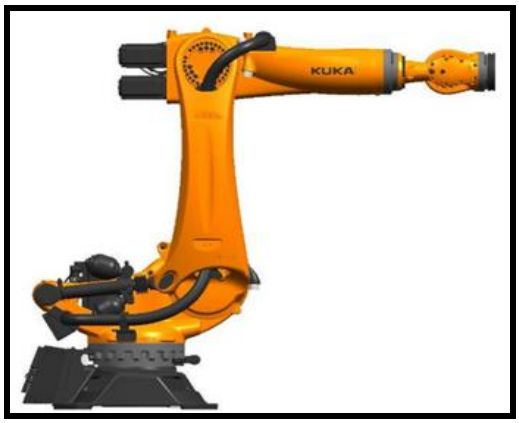
III. PROBLEM FORMULATION

Through various papers, it has been found that studying various parts of robotic arm is difficult and time consuming.. Before actually creating a robotic arm the design, various requirements and behavior of a robotic arm can be studied. It is a cost efficient method as it will enable to create error free robotic arm. This 3D robotic arm can be easily customized based on the requirements or changes provided. There are packages like LabVIEW, MATLAB Simulink, SimMechanics, and Free CAD which support such an environment for programming and visualization. None of the literature surveyed so far reported how to integrate a CAD model of a robot to a simulation software environment to study its behaviour. CATIA software is being used for composite design due to its ability to manage geometries better than standard composite design solutions. It will also save time and money by avoiding restarting the design process with automatic updates. Further simulation is carried out in PowerMILL which simulates the tool path to be traced by arm during machining process. The simulation parameters are shown graphically in form of time graphs.

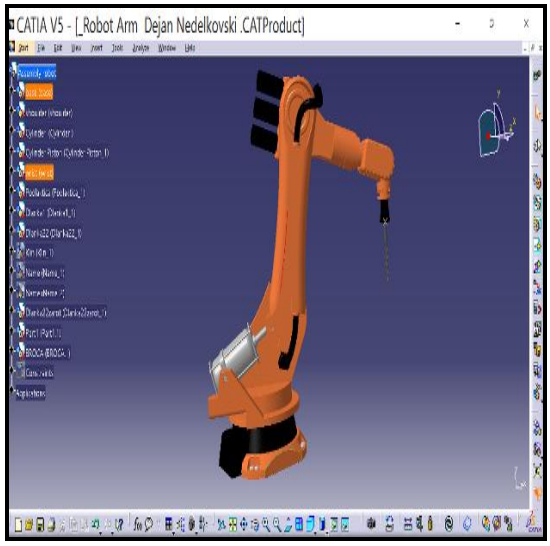
IV. METHODOLOGY

KUKA configuration for robotic arm will be designed and simulated using CATIA and PowerMILL. These arms are commonly used in assembly operations. The robotic arm to be studied will have six degrees of freedom for faster and accurate and repeatable movements. CATIA software is used for design and simulation of robotic arm. It will also save time and money by avoiding restarting the design process with automatic updates,

- Firstly the requirement of robotic arm will be accumulated and modeled in the form of drawing which is drafted in 2d sketch in CATIA.
- Then the detailed assembled 3D solid view will be generated in CATIA using commands and constraints conditions..
- Then final model will be analyzed for getting idea about its total workspace consumption during its working in actual form.
- Finally the generated 3D model will be simulated in PowerMILL to predict the behaviour of actual robotic arm during its working within its workspace.
- Then the simulation is analysed in form of angular velocity time based graph generated in PowerMILL.



Actual View of Kuka Robotic Arm

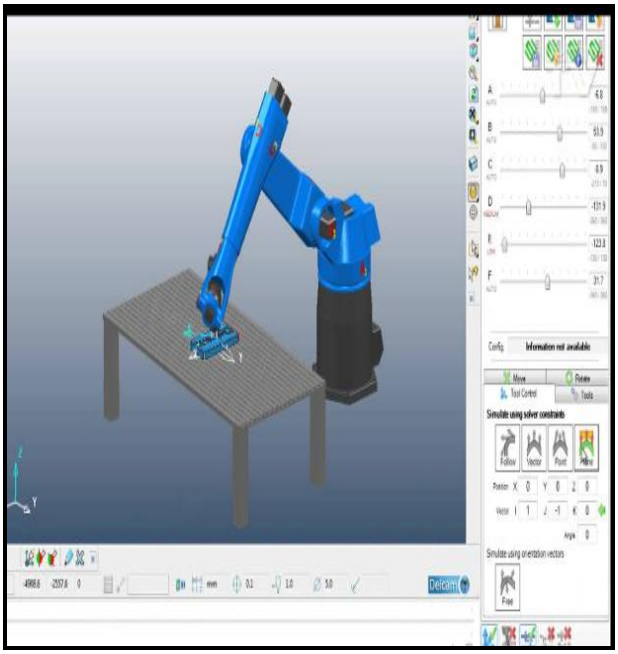


Generated 3d view of Kuka robotic arm in CATIA

V. SIMULATION

Simulation has been recognized as an important research tool since the beginning of the 20thcentury.First, the analog computers and later the digital computers have boosted simulation to new levels. Simulation is now a powerful tool supporting the design, planning, analysis, and decisions in different areas of research and development. POWERMILL is a 3D computer-aided manufacturing solution for the

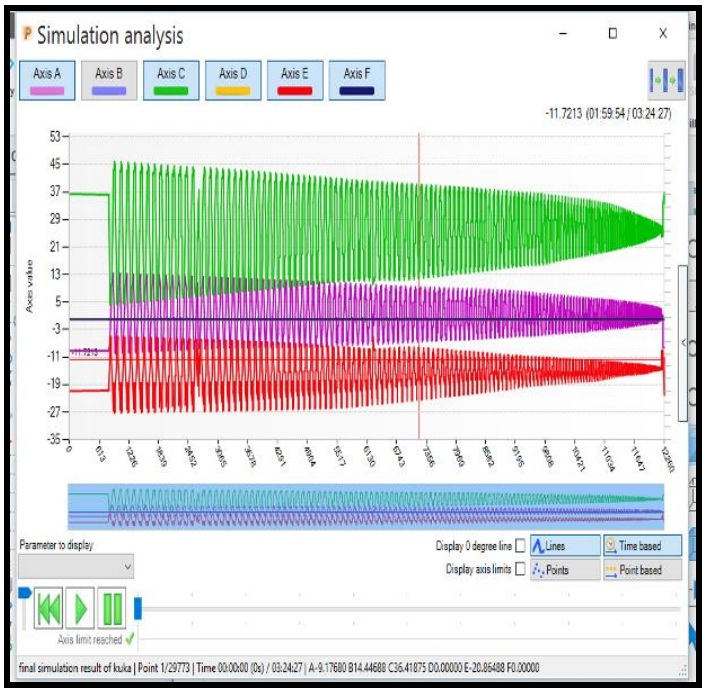
programming of tool paths up to 6 axis CNC Milling machines developed by Autodesk Inc. It is the solution leading on the market for programming machining of complicated 3D surfaces. First of all simulation of Kuka robotic arm designed in CATIA and then the final design transferred in PowerMill in order to study its simulation .In this way, the actual robot joint effects can be foreseen at the engineering stage acceleration, smoothing values and other robot specific parameters can be defined.



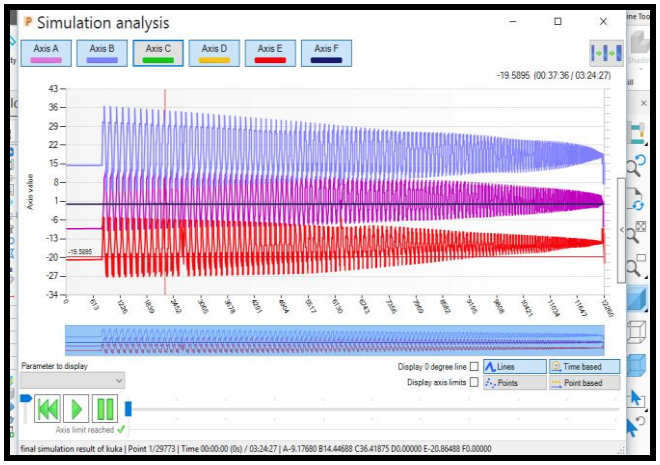
Simulation Process in PowerMILL

VI. SIMULATION RESULTS

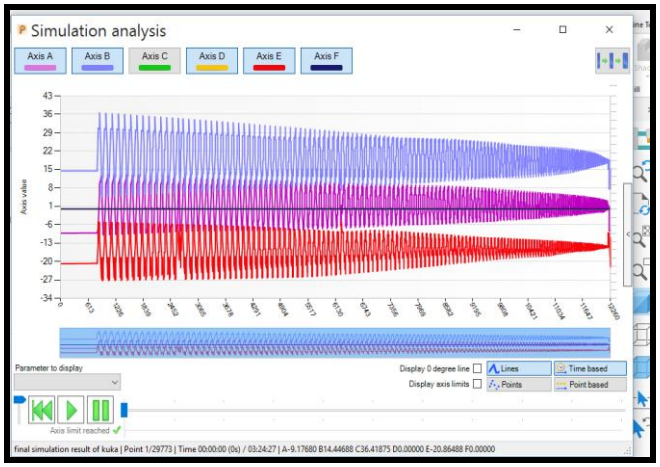
Graphs display the axis limits, wrist singularity and axis reversals to give a better understanding of how the robot will move. Simulation process is depicted in the form of time and displacement graphs for different axes of motion of arm. Simulation graphs corresponding to each axes of rotation of robotic arm are shown in figures



Simulation graph of Axis A

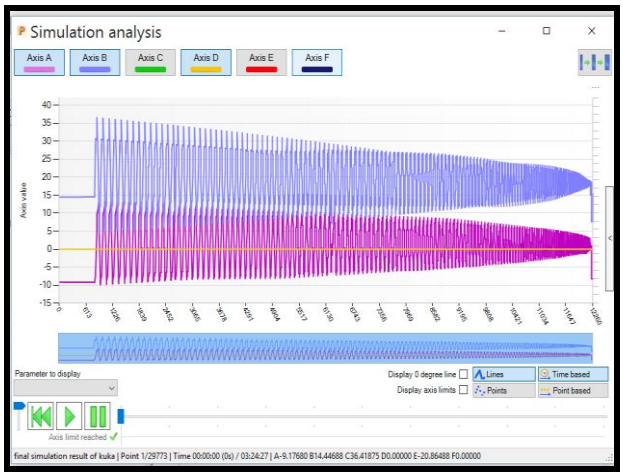


Simulation graph of Axis B



Simulation graph of Axis C

Simulation graph of Axis D



Simulation graph of Axis E

Simulation graph of Axis F

VII. CONCLUSION

Automation and hazard reduction in the workplace are two important factors of driving the use of robotics, specially articulated arm robots, in order for decreasing human deaths and injuries, economically affordable production plus saving time. Using CATIA 3D cad model of Kuka robotic arm was generated from data and 2d part drawing provided by their vendors with all its geometrical parameters. The robot's assembly was then exported using POWERMILL to simulate the tool paths using the specified parameters, The imported model was transferred in PowerMILL directory to analyze the simulation in the form of time displacement graphs. So this technology can use in different robot in different field to know the joint angles, orientations, and the robot working space.

VIII. REFERENCES

[1]. A. Ali, M. Madariaga and D. McGeary (2007),"Assistive robotic arm" Final Year Project Report,

[2]. M. Hershey, C.Menezes, B Walzade and Prof. L.G.Navale,(2007) "An Innovative Multi robotic Arm assembly for press shops", Final Year BE Project Report,

[3]. R. Krishna, G. S. Bala, A. S. C. S Sastry, B. B. P Sarma and G. S. Alla,"Design and Implementation of a Robotic Arm based on Haptic Technology", Int. J. of Eng Research and Applications, vol. 2.no. 34.

[4]. Aburaia, Mohamed, Erich Markl, and Kemaj Stuja. "New Concept for Design and Control of 4 Axis Robot Using the Additive Manufacturing Technology."Procedia Engineering 100,pp.1364-1369

[5]. Datu Derin and Nurul Atikah. (2015). "Finite Element Analysis on Robotic Arm for Waste Management Application." Applied Mechanics & Materials Vol. 786,

[6]. Miclosina, Zoltan Losif Korka, and Vasi'e Cojocaru (2015), "Influence of Link Lengths on the workspace of a Parallel Topology Robot." Applied Mechanics and Materials, Vol. 762.

[7]. Conkur E. S. and Buckingham R (1997), "Clarifying the definition of Redundancy as used in Robotics. Robotica,Vol. 5

[8]. Maeda, Sho, (2011). "Development and control of pneumatic robot arm for industrial fields." IECON, 2011-37th Annual Conference on Industrial Electronics Society (IEEE).

[9]. Elfasakhany, Ashraf, (2011)"Design and development of a competitive Low-cost robot arm with four degrees of freedom." Modern Mechanical Engineering 1.02,

[10]. Milind R.Shinde, V.N. Bhaiswar, B.G. Achmare "Designing a suitable robotic arm for loading and unloading of material on lathe machine using workspace simulation software" ISO 9001:2008 Certified Journal.

[11]. M. Baboria, M Kainth (2018) ; "Literature Review On Design And Simulation Of Industrial Robotic Arm using Cad Cam Software" International Journal of Science and Computing, March 2018 volume 8; issue 3 ISSN 2321 3361@IJESC,pp.16630-33