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Fabrication and Analysis of 3D Printed Fused Deposition PLA Model

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A B S T R A C T

Fabrication is the process manufacturing a new component by using one or more individual processes. This paper talks about fabrication by using additive manufacturing in fused deposition modeling PLA component assembly. In these assembly having different types of components in which mechanical stresses will be exist. In this the design analysis and Fabrication Analysis in the IRON CAD and ANSYS respectively will be determined by detailed overview. By enabling the PLA materials, the form of new modeled designs is manufactured. Some important components in the future point of view are Water cooler frame, Human Arm Type Robotic Arm, Bone structure and Insulating components etc.

Fused Deposition Modelling (FDM) is an extrusion based Additive Manufacturing (AM) technology in which thermoplastic materials are melted and extruded through a nozzle onto a build platform in layer-by-layer manner .Compared to conventional energy-intensive techniques: ability to fabricate complex geometries as a single unit/part with no joints, lower material and labour cost, good surface finish, lower energy demand, single step processing temperature, less process complexity (CAD model-Print-Install), near net shape finish, quick production time, short lead time, less overall cost. Most important types of techniques are material modeling, Material finishing and Electron, Laser beam techniques will successfully be achieving in fabrication and 3D printing now a days.

Keywords: Robotic arm, Iron cad, Ansys, Ultimaker cura 2+, Design, Analysis, Extrusion, CAD model, Fabrication, Manufacturing system.

1. Introduction:

This study mainly focuses on the analytical approach to design a 3D printed Fused deposition modeling polylactic acid (PLA) component. The accuracy is far greater than what a Traditional manufacturing. These plasticized materials are very much in strength when compared to ABS and other 3D printed plastics. Some PLA materials are: Racemic PLLA, Regular PLLA, PDLA (Poly-L-Lactic Acid) etc. Coming to Engineering Applications the manufacturing of New modelized materials is cost effective manner and used for multi purposes. This study seeks to analyse the reduced mechanical properties of a 3D printed material by analysing 3D model sample in FEA software .The sample will first be modelled as an isotropic model, although they are of PLA material, then modelled in an FDM-3D printed composite. These results will be compared to each other, as well as to existing material property testing of FDM-3D printed materials.

The goal of Fabrication analysis in today's market is to produce high quality parts with max productivity, minimal cost and time value with respect to safety purpose also. FDM is the second most popular technique after stereolithography. The different manufacturing parts, the companies are created are therefore can withstand the stresses, strains, elasticity and Plasticity etc. The Nodal analysis and thermal analysis, stress analysis will be determined here of the ROBOTIC ARM component in the ANSYS software. Here load distribution plays a Critical role by analyzing how much strength it can withstand. Normally up to 5 MPA, the component can withstand its properties .

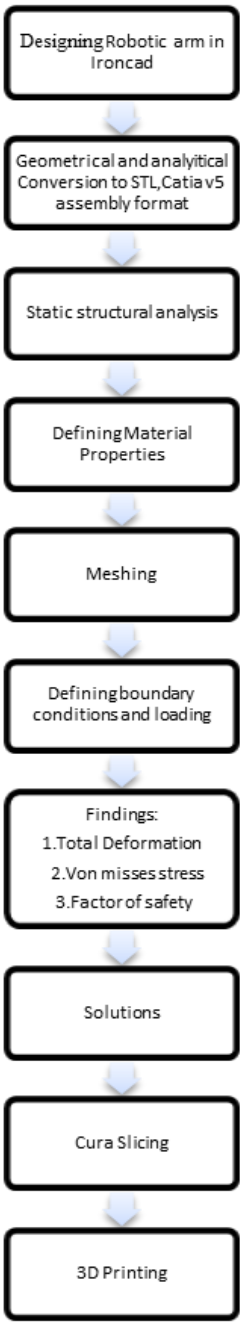
Main Menu------- Pre-processor---------Loads-------- define loads ---------- Apply----- Structural ---------Pressure---------On areas-------ok.

Behalf of these structural static analysis is also an essential procedure to design a structural Arm type component. Using static analysis, the structures response to the applied external forces is obtained. Moreover, the static analysis is performed when the structure is subjected to the external displacements, such as differential support settlements(boundary condition).

1.1 Methodology

First of all, click on the start button and enter into the Iron cad. From that design the robotic arm with clear cut measurements and Annotations. From this convert the Geometric cad model into the STL file and CATIA v5 assembly format. Then export Catia v5 the file format into the ANSYS. Now from the ANSYS software click on the Static Structural Analysis and define the material properties. After that mesh the component for accurate results. Now define the boundary conditions. At last, go to solutions we get the Solutions from Ansys software for the required component. Slicing the 3D model which has been analysis with best result. Final print the component.

1.2. Processes chart



1.3 Structure

The Robotic Arm is having Four degree of freedom. It is designed to perform Various weightlifting operations. Our goal is to minimize the cost and maximize the performance in terms of weight lifting. It is having improved to the point where they can perform various functions very easily and also having the capacity to do work under safe conditions. A 4 degree of freedom robotic arm is designed in this research. The study involves the design, analysis and fabrication of PLA component (Material controlling robotic arm). This study presents various analysis on the Robotic arm. By using ANSYS Software, the design is optimized according to the safe factor. This Process can easily use to customized the design based on Dimensional Parameters.

1.4 Construction of references

The robotic arm to follow the assigned geometric path in high precision and accurate manner, by introducing of designing and development of boundary conditions and degrees of freedom 0.Robotic and automation, optimization of the design through analysis is very essential. It also reduces the cost of

product and increases the life cycle2**.**The works aims to explore the possibilities of modular components with localized composite reinforcement that aids in the optimization of the component in terms of functionalities, flexibility, rigidity and cost3**.**FDM PLA components are limited in fatigue characteristics even though they exhibit similar ultimate stress limits as with bulk materials, warranting further research in improving FDM parts expected to experience cyclical loads4**.**The effects of fused deposition modeling process parameters on the tensile propertied of fused deposition modeling- fabricated carbon fiber- reinforced plastic composite components are investigated. The fracture interfaces of the parts after tensile testing are observed by scanning electron microscope to explain failure modes in the scenario 5**.**

The components of are still capable of manufacturing complex geometric shapes and cavities with a reasonable dimensional accuracy. Therefore, the progress in fused deposition technique attempts to improve the end performance of 3D printed parts with current challenges [6]. Fabrication and formulation with rapid profiles via FDM 3DP technique is a challenge. The profiles was chosen by physical modifications7**.**The performance of PLA filler application, allowing the production of well-formed filament that can be used for 3D printing, light weight and thermal insulating components for constructing sector 8**.**The gaps in PLA component can be fatigue characteristics of PLA parts processed through FDM and in engineering design applications under cyclic loads9.The design and fabrication are detailed by the performance of resulting structural analysis of a desired component 10.

1.5 Constructional details:

STEP 1: first of all, the 3D printed components will be manufactured in the 3D printed machine.

STEP 2: From this, make the arrangements on the bench where the components or parts will be assembled.

STEP 3: Later on, take one – one part each after that attach with the screws of the base part.

STEP 4: Now attach the body or center part throughout the manufacturing/fabricated system.

STEP 5: Apply with bolts and paste with glue of the upper and side parts.

STEP 6: After that ensure that by the Static Structural Analysis, the prototype will be designed with some material properties: such as Density, Temperature, Time, no of divisions, Length, volume etc.

1.6 Modelling:

Modelling a design by using drag and drop and sketch methods are used to design a component in a best way. By using Geometric data and material type.

Fig:1 Designing 3D cad model

1.7 Materials:

1. PLA material with third order plastics.
2. Filing materials
3. Surface finish accuracy meter.
4. Some parts of Screws and bolts

1.8 Analysis:

The entire analysis of the robotic arm is done in ANSYS workbench. Widely used for static structural analysis. This software gives accurate results as that of the real-life simulation materials. Before the fabrication Ansys reformation this analysis and prevent the bad designed parts. The strong and weak areas of the robotic arm are shoulder and the base. These areas are classified differently through which the design is improved and some material choices are made. Throughout the FEM and FEA, the designs of so many parts can be made. Under these considerations how much load the component should vary, how much it can withstand without breakable and analyze the fatigue behavior. These all are depending upon the material properties of the material and vice versa.

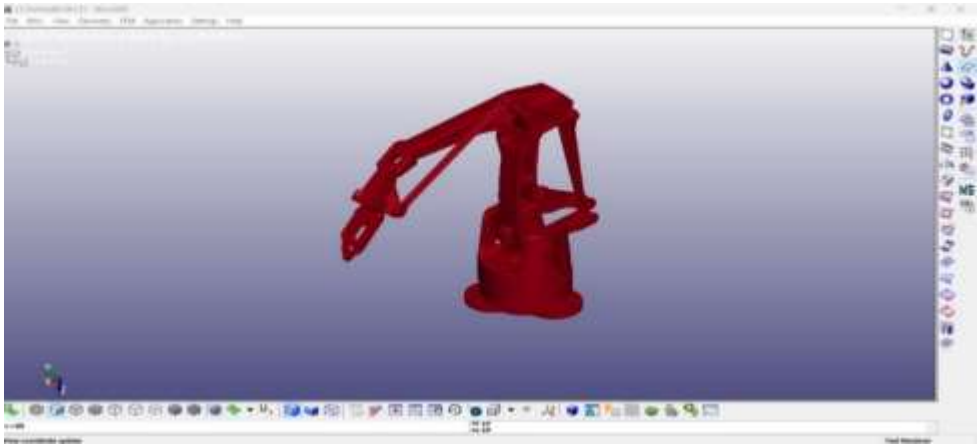


Fig:2 Static Analysis by Ansys

Meshing:

A tetrahedral mesh is generated in model. At each small partition of mesh is called an element. If the element size is small, a fine mesh is generated, what it essentially does is that it splits a very large problem into many small problems. Thus, greatly reducing the required to analyze the model.

After meshing, the fundamental deviations in that component will be reduced in slight deformable changes. It can effort spends to get to accurate results. Since meshing typically consumes a significant portion of the time it takes to get simulation results, Ansys helps by making better and more automated meshing tools.

Slicing:

A Stereolithography (STL) as geometrical file is used to generate a 3D component through Fused deposition modeling has been analyzed best design safety. The components must be with Infill density must be constant with respect to density taken in the Ansys. The moto is to best results from orientation and speed. And apply skirt support at bottom of the component for surface accuracy. Slicing is the extraction of a part string, list or tuple. It enables users to access the specific range of elements by mentioning the indices.

Fig:3 Slicing for X max 3D printer

2. Result:

The Material properties consists from two different scenario taken in Ansys. In the entire body of robotic consists of Isotropic composition has been analyzed and also the gripper and body parts can be analyzed. From the it can be clearly observed that the second scenario give the quite better results. Hence the main body part and base part are made or assigned with PLA for best lifting conditions.

Fig:4 Final 3D printed components

3. Conclusion

In this paper, the robotic arm is modelled in iron cad parametric and is analyzed in Ansys work bench. To determine the von mises stress, total deflection, factor of safety of Polylactic Acid component for fused deposition modeling operation. For future research and Development: Speed, resolution, functionality some material options for 3D Printed material parts most useful and prospective areas for future research and developments.

In 2025 beyond we will see more applications of 3D printing in automobile, aerospace and manufacturing industries with more Designed purposes. It can open up several new opportunities to build prototypes.

Fig: 5 FINAL Output component

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