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Methods To Improve 3D Prints By Reducing Artifacts Caused By Vibration And Noise

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***Abstract*—The paper presents the state-of-the-art improvements in 3D printing technology by introducing state-of-the art laser based measurement and dynamic and static noise and vibration dampening systems.**

Keywords—measurement, dynamic, static, vibration, dampening

I INTRODUCTION

Fused deposition modeling (FDM) is a process by which functional parts can be rapidly produced by sequential deposition of fused material layers. Various severe inaccuracies such as artefacts and dimensional distortions anddelimitations are attributed to vibration and inertia built up during operation. Their magnitude is largely influenced by the selected process parameters. This study investigates the increase in the surface finishes and dimensional accuracy due to the reduction of noise and vibrations . Two important parameters were considered: (a) vibration propagation through the machine (b) sources of vibration in the machine. [1]Hideo Kodama of Nayoga Municipal Industrial Research Institute is generally regarded to have printed the first solid object from a digital design. Here our idea is to decrease any sort of external vibrations and disturbances that may arise during the working of the machine.

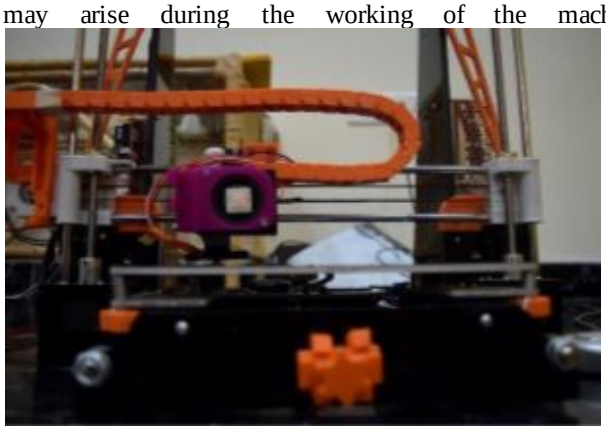

Fig.1. 3D Printing Machine

II LITERATURE

The 3D printing technologies, comparing to traditional techniques of constructing the buildings, could be considered as environmental friendly derivative giving almost unlimited possibilities for geometric complexity realizations[1]. In the next decades, this technology has been substantially improved and has evolved into a useful tool for researchers, manufacturers, designers, engineers and scientists[2].

III METHODOLOGY

A. MODELLING

printable models can be created with the help of CAD design packages or via 3D scanner. The manualmodeling process of preparing geometric data for 3D computer graphics is similar to method sculpting. 3D modeling is a process of analyzing and collecting data on the shape and appearance of an object. Based on this data, 3D models of the scanned object can be produced. Both manual and automatic creations of 3D printed models are very difficult for average consumers. That is why several market-places have emerged over the last years among the world. The most popular are Shape ways, Thing verse, My Mini Factory, and Threading.

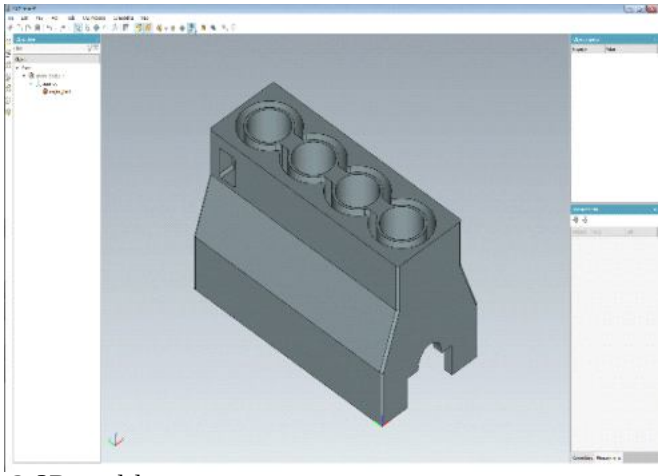

Fig.2. 3D model

B . PRINTING

Before printing a 3D model from. STL file, it must be processed by a piece of software called a "slicer" which converts the 3D model into a series of thin layers and produces a G-code file from. STL file containing instructions to a printer. There are several open source slicer programs exist, including, Slic3r, KISSlicer, and Cura. The 3D printer follows the G-code instructions to put down successive layers of liquid, powder, or sheet material to build a model from a series of cross-sections of a model. These layers, which correspond to the virtual cross sections from the CAD model, are joined or fused to create the final shape of a model. The main advantage of this technique is its ability to create almost any shape or geometric model. Construction of a model with existing methods can take anywhere from several hours to days, depending on the method used and the size and complexity of the model. Additive systems can typically reduce this time to very few hours; it varies widely

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depending on the type of machine used and the size and number of models being produced.

Fig.3. chemical Finishig

C. POST PROCESSING

Although the printer-produced resolution is sufficient for many applications, printing a slightly oversized version of the object in standard resolution and then removing material with subtractive methods or chemical finishing by immersing the material soluble solution for welding or surface finishing to give a good appearance.

CAUSES FOR VIBRATION AND NOSIE

A 3d printer being an machine in motion during operation it is subjected to various types of vibrations and shocks.
The vibrations generally arise from the below mentioned causes

A) MOTORS
3d printers mostly use stepper motors which are inheritently noisy because of higher harmonic content of stator current, power supply voltage fluctuation and excitation current waveform.

B) FRAME
Some 3d printers come with hollow frames and plastic components which further aggravate the noise propagation.

C) MOTION SYSTEM
Due to the extensive use of linear rails as a medium to move the gantry and bed this causes a stick and slip phenomenon and causes artifacts to arise in the work surface.

D) LACK OF FRAME SUPPORT
As 3d printers are mostly folly Cartesian and delta type designs the fames are subjected to vibration at the top most

A. Proposed solutions

- FOR MOTORS

Use of T-L SMOOTHER, T-L smoothers help with evening out the signal going through stepper motors on a 3D printer, specifically the notoriously noisy RV8825 motor drivers. This addition to both X-axis motor and Y-axis motor enables it to produce smooth motion and reduce the effect of salmon skin.

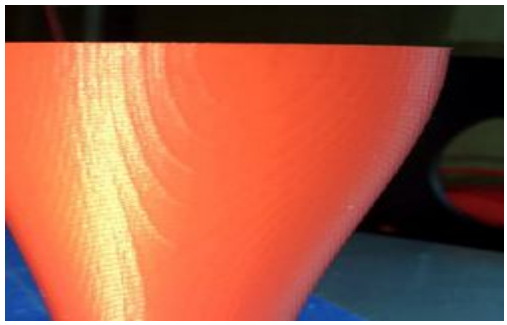

Fig.4 formation of layer

1) Use of RUBBER DAMPENERS, this is based on the fact that all moving components produce slight noise and vibration and rubber being a good sound and vibration absorption property, they are placed in between the motor mounting so prohibit any *propagation* of vibration to the printer frame.

Fig.5.Frame

- FOR FRAME

1) Use of SOLID EXTRUDED aluminum or steel extrusions as the frame of the printer, as both aluminum and steel do not pohibt exesive flexure in themselves thus large flexing of the frame does not take place thus reducing dimensional inacuracies of the printed components.

- FOR MOTION SYSTEMS

2) Use of roller wheel based movements to reduce the possibility of friction caused due to movment.

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Fig.5.Rubber Dampers

B. Specifications and requirements of the printer

- Basic dimensions: 1000mm X 1000mm X1000mm
- Bed size: 400mmX400mm
- Printer speed: 200mm/sec
- Material recommended: PLA
- Extruder max temperature: 300° c
- Bed max temp : 120° c

ADDITIONAL ACCESSORIES

- T-L smoothers
- Rubber dampners
- Electromechanical indicators (bed levellers)
- Vibration isolation cage
- Air filtration system

C. Advantages

- Time-to-Market: 3D printing allows ideas to develop faster. Being able to print a concept on the same day it was designed shrinks a development process from what might have been months to a number of days, helping companies stay one step ahead of the other
- Save Money: Prototyping injection mould tools and production runs are expensive investments. The 3D printing process allows the creation of parts and/or tools through additive manufacturing at rates much lower than traditional machining.
- Mitigate Risk: Being able to verify a design before investing in an expensive molding tool is worth its weight in 3D printed plastic, and then some. It is far cheaper to 3D print a test prototype than to redesign or alter an existing mould
- Get the Feel: One thing you can't get a picture or virtual prototype on the computer screen is the way something feels in your hand. If you want to ensure the ergonomics and fit of a product are just right, you must actually hold it, use it and test it.
- Personalize It: With standard mass-production, all parts come off the assembly line or out of the mould the same. With 3D printing, one can personalize, customize a part to uniquely fit their needs, which allows for custom fits in the medical industries and helps set people to elaborate their idea in new world
- Fail Fast, Fail Cheap: 3D printing allows a product developer to make breakthroughs at early stages that are relatively inexpensive leading to better products and less expensive dead-ends.

D. Disadvantages

- Intellectual property issues: The ease with which replicas can be created using 3D technology raises issues over intellectual property rights. The availability of blueprints online free of cost may change with for-profit organizations wanting to generate profits from this new technology.
- Limitations of size: 3D printing technology is currently limited by size constraints. Very large objects are still not feasible when built using 3D printers.
- Limitations of raw material: At present, 3D printers can work with approximately 100 different raw materials. This is insignificant when compared with the enormous range of raw materials used in traditional manufacturing. More research is required to devise methods to enable 3D printed products to be more durable and robust
- Cost of printers: The cost of buying a 3D printer still does not make its purchase by the average householder feasible. Also, different 3D printers are required in order to print different types of objects. Also, printers that can manufacture in color are costlier than those that print monochrome objects

IV.APPLICATIONS

The shock dampening technology is applicable in the following areas.

- High speed 3D printing. Since 3d printing components in high speed reduces quality due to various factors as discussed above.
- Printing large components. As printing large components the dimensional and surface finishes are drastically reduced due to the increase in vibrations and inertia caused by the mass of the gantry.

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- Printing of food or viscous pastes. As viscous pastes and soft materials when printed will easily deform and fail due to the vibrations caused by the machine itself.

IV.CONCLUSION

3D Printing technology could revolutionize the world. Advances in 3D printing technology can significantly change and improve the way we manufacture products and produce goods worldwide. An object is scanned or designed with Computer Aided Design software, then sliced up into thin layers, which can then be printed out to form a solid three-dimensional product.

But as this is a relatively new field it does possess some flaws in the system, this paper seeks to solve one such facet of that problem which is reducing vibration caused by the machine and how to reduce such problems by providing possible solutions that are available in the market as of now.

Such small improvements in the overall design and making such small advancements standards in the field a greater product can be produced and the overall field can benefit by expanding its boundaries and making the impossible happen.

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