

ADVANCED RAPID PROTOTYPING TECHNIQUES

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Abstract- Rapid prototyping is a group of techniques used to quickly fabricate a scale model of a physical part or assembly using three-dimensional computer aided design (CAD) data. . Rapid application development (RAD) is a software development methodology that uses minimal planning in favor of rapid prototyping. The "planning" of software developed using RAD is interleaved with writing the software itself. In this paper we will discuss about the process how rapid prototyping is done and we will study the applications and uses of advance rapid prototyping techniques.

I. INTRODUCTION

Rapid Prototyping (RP) by layer-by-layer material deposition started during early 1980s with to us growth in Computer Aided Design and Manufacturing (CAD/CAM) technologies when almost unambiguous solid models with knitted information of edges and surfaces could define a product and also manufacture it by Computer Numerical Control (CNC)machining. RP process belong to the generative (or additive) production processes unlike subtractive or forming processes such as lathing, milling, grinding or coining etc. in which form is shaped by material removal or plastic deformation. *The "three dimensional printers" allow designers to quickly create tangible prototypes of their designs rather than two dimensional pictures. Such models have numerous uses. They make excellent visual aids for communicate in g ideas with co-workers or customers apart from design testing. For example Aerospace Engineer might mount a model aerofoil in a wind tunnel to measure lift and drag forces. Across the world, Engineering has the common language and common goal-"Improving the Quality of Life" of mankind without any boundary restrictions.* stands for rapid prototyping and this in turn refers to as a group of techniques used to quickly fabricate a scale model of a physical part or assembly using three-dimensional computer aide d design (CAD) data. It is also known as a class of technologies and is defined, for the purpose of primer ,as a 'diverse' set of

technological tools and resources that can automatically construct physical models from computer-Aided Design (CAD) data. At least six different rapid prototyping techniques are commercially available ,each with unique strengths. As on date RP techniques are being increasingly used in no prototyping applications, these techniques are often collectively referred to as: Solid free-form fabrication, computer automated manufacturing or layered manufacturing.

II. RAPID PROTYPING TEQNIQUES AND APPLICATIONS

The term rapid prototyping (RP) refers to a class of technologies that can automatically construct physical models from Computer-Aided Design (CAD) data. These "three dimensional printers" allow designers to quickly create tangible prototypes of their designs ,rather than just two-dimensional pictures. Such model shave numerous uses. They make excellent visual aids for communicating ideas with co-workers or customers .In addition, prototypes can be used for design testing .For example, an aerospace engineer might mount a model airfoil in a wind tunnel to measure lift and drag forces.

a) *Stereo Lithography*

Patented in 1986, stereo lithography started the rapid prototyping revolution. The technique builds three dimensional models from liquid photosensitive polymers that solidify when exposed to ultraviolet light., the model is built upon a platform situated just below the surface in a vat of liquid epoxy or acryl ate resin. A low-power highly focused UV lasertraces out the first layer, solidifying the model's cross section while leaving excess areas liquid.

b) *Selective Laser Sintering*

Developed by Carl Deckard for his master's The sis at the University of Texas, selective lasers intering was patented in 1989. It uses a laser beam to selectively fuse powdered materials, such as nylon ,elastomer, and metal, into a solid object. Parts are

built upon a platform which sits just below the surface in a bin of the heat-powder.

b) Laminated Object Manufacturing :

In this technique, developed by Helisys of Torrance, CA, layers of adhesive-coated sheet material are bonded together to form a prototype. The original material consists of paper laminated with heat-activated glue and rolled up on spools., a feeder/collector mechanism advances the sheet over the build platform, where a base has been constructed from paper and double-sided foam tape. Next, a heated roller applies pressure to bond the paper to the base. A focused laser cuts the outline of the first layer into the paper and then cross-hatches the excess area (the negative space in the prototype). Crosshatching breaks up the extra material, making it easier to remove during post-processing. During the build, the excess material provides excellent support for overhangs and thin-walled sections. After the first layer is cut, the platform lowers out of the way and fresh material is advanced. The platform rises slightly below the previous height, the roller bonds the second layer to the first, and the laser cuts the second layer. This process is repeated as needed to build the part, which will have a wood-like texture. Because the models are made of paper, they must be sealed and finished with paint or varnish to prevent moisture

III. APPLICATIONS OF RAPID PROTOTYPING

Rapid prototyping is widely used in the automotive, aerospace, medical, and consumer products industries. Although the possible applications are virtually limitless, nearly all fall into one of the following categories: prototyping, rapid tooling, or rapid manufacturing.

Prototyping:

As its name suggests, the primary use of rapid communication and testing purposes. Prototypes dramatically improve communication because most people, including engineers, find three-dimensional objects easier to understand than two-dimensional drawings. Such improved understanding leads to substantial cost and time savings. Effective communication is especially important in this era of concurrent engineering. By exchanging prototypes early in the design stage, manufacturing can start tooling up for production while the art division starts

planning the packaging, all before the design is finalized.

a) Rapid Tooling:

A much-anticipated application of rapid prototyping is rapid tooling, the automatic fabrication of production quality machine tools. Tooling is one of the slowest and most expensive steps in the manufacturing process, because of the extremely high quality required. Tools often have complex geometries, yet must be dimensionally accurate to within a hundredth of a millimeter. In addition, tools must be hard, wear resistant, and have very low surface roughness (about 0.5 micrometers root mean square). To meet these requirements, molds and dies are traditionally made by CNC-machining, electro-discharge machining, or by hand. All are expensive and time consuming, so manufacturers would like to incorporate rapid prototyping techniques to speed the process. Peter Hilton, president of Technology Strategy Consulting in Concord, MA, believes that "tooling costs and development times can be reduced by 75 percent or more" by using rapid tooling and related technologies. Rapid tooling can be divided into two categories, indirect and direct.

IV. CONCLUSION

Despite the recent advancements and successes of rapid prototyping, there are various limitations which still exist. The first and foremost issue is the high cost associated with rapid prototyping. A lack of cost estimation and cost analysis of rapid prototyping technologies has brought about uncertainties for industrial applications. Secondly, rapid prototyping systems are limited by the materials which may be used. Casting is a technique where a metal part is created by pouring molten metal into a mold or a die. Compared to all metal forming processes, casting is one of the most direct processes to acquire a finished product from a component design. Due to the flexibility of the process, castings may virtually be of any shape, size, or weight. In this paper we represent a survey of performance based advanced rapid prototyping techniques. During the survey, we also find some points that can be further explored in the future, such as Rapid Prototyping with Vacuum Casting Methodologies.

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