

3D PRINTING OFFERS ABILITY TO PRINT PHYSICAL OBJECTS

Znamenshchikov Y. – student ES-71

Pochatko T. V. – E L Adviser

3D printing is a form of additive manufacturing technology where a three dimensional object is created by laying down successive layers of material. 3D printers are generally faster, more affordable and easier to use than other additive manufacturing technologies. 3D printers offer product developers the ability to print parts and assemblies made of several materials with different mechanical and physical properties in a single build process.

A 3D printer works by taking a 3D computer file and using and making a series of cross-sectional slices. Each slice is then printed one on top of the other to create the 3D object.

Methods

A large number of competing technologies are available to do 3D printing. Their main differences are found in the way layers are built to create parts. Some methods use melting or softening material to produce the layers, e.g. selective laser sintering (SLS) and fused deposition modeling (FDM), while others lay liquid materials that are cured with different technologies. In the case of lamination systems, thin layers are cut to shape and joined together.

One method of 3D printing consists of an inkjet printing system. The printer creates the model one layer at a time by spreading a layer of powder (plaster, or resins) and inkjet printing a binder in the cross-section of the part. The process is repeated until every layer is printed. This technology is the only one that allows for the printing of full colour prototypes. This method also allows overhangs. It is also recognized as the fastest method.

In digital light processing (DLP), a vat of liquid polymer is exposed to light from a DLP projector under safelight conditions. The exposed liquid polymer hardens. The build plate then moves down in small increments and the liquid polymer is again exposed to light. The process repeats until the model is built. The liquid polymer is then drained from the vat, leaving the solid model.

Another approach is selective fusing of print media in a granular bed. In this variation, the unfused media serves to support overhangs and thin walls in the part being produced, reducing the need for auxiliary temporary supports for the workpiece. Typically a laser is used to sinter the media and form the solid.

Finally, ultra-small features may be made by the 3D microfabrication technique of 2-photon photopolymerization. In this approach, the desired 3D object is traced out in a block of gel by a focused laser. The gel is cured to a solid only in the places where the laser was focused, due to the nonlinear nature of photoexcitation, and then the remaining gel is washed away. Feature sizes of under 100 nm are easily produced, as well as complex structures such as moving and interlocked parts.

Applications

Standard applications include design visualization, prototyping/CAD, metal casting, architecture, education, geospatial, healthcare and entertainment/retail. Other applications would include reconstructing fossils in paleontology, replicating ancient and priceless artifacts in archaeology, reconstructing bones and body parts in forensic pathology and reconstructing heavily damaged evidence acquired from crime scene investigations.

3D printing technology is currently being studied by biotechnology firms and academia for possible use in tissue engineering applications where organs and body parts are built using inkjet techniques. Layers of living cells are deposited onto a gel medium and slowly built up to form three dimensional structures. Several terms have been used to refer to this field of research: Organ printing, bio-printing, and computer-aided tissue engineering among others.

The use of 3D scanning technologies allow the replication of real objects without the use of molding techniques, that in many cases can be more expensive, more difficult, or too invasive to be performed; particularly with precious or delicate cultural heritage artifacts where the direct contact of the molding substances could harm the surface of the original object.