ASME Historic Mechanical Engineering Landmark

Stereolithography

The First 3D Printing Technology

Designated May 18, 2016

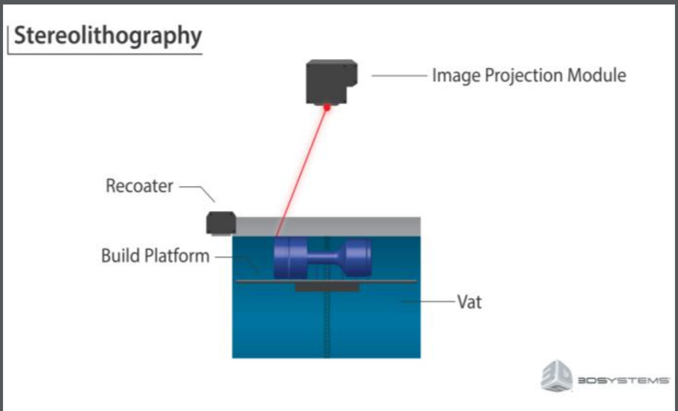
The American Society of Mechanical Engineers

ASME

SETTING THE STANDARD

Historical Significance of the Landmark

Stereolithography is recognized as the first commercial rapid prototyping device for what is commonly known today as 3D printing. 3D printing is revolutionizing the way the world thinks and creates, and has been identified as a 'disruptive technology' – an innovation that has displaced established technologies and created new industries.



Stereolithography process

While the origins of 3D printing date back to the 19th century, it wasn't until the 1980s that the technology began to flourish. In 1983, Charles (Chuck) Hull developed a prototype system referred to as stereolithography, in which layers are added by curing photopolymers with ultraviolet (UV) lasers. He defined the process as a "system for generating three-dimensional objects by creating a cross-sectional pattern of the object to be formed."

Mr. Hull made two significant contributions that advanced the viability of 3D technology:

- He designed/established the STL file format that is widely accepted for defining 3D images in 3D printing software.
- He established the digital slicing and in-fill strategies common in most 3D printing processes.

Mr. Hull obtained patent no. 4,575,330 (filed August 8, 1984) for an "Apparatus for production of three-dimensional objects by stereolithography." In 1986, he co-founded 3D Systems, Inc. (3D Systems) to commercialize the technology. 3D Systems introduced their first 3D printer, the SLA-1, in 1987.

ASME Landmark Plaque Text

3D Systems SLA-1 3D Printer | 1987

This is the first 3D printer manufactured for commercial sale and use. This system pioneered the rapid development of additive manufacturing, a method in which material is added layer-by-layer to form a solid object, as opposed to traditional manufacturing in which material is cut or machined away. The SLA-1 is based on stereolithography, using a precisely controlled beam of UV light to solidify liquid polymers one layer at a time.

Chuck Hull developed stereolithography in 1983 and formed 3D Systems to manufacture and market a commercial printer. 3D printers based on Hull's design are now widely used to make complex components in a wide variety of materials.

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3D Printing Applications

Rapid prototyping, also known as 3D printing or 'additive manufacturing', has become the leading technology for the rapid prototyping of new products, resulting in reduced production time and cost. Unlike traditional 'subtractive manufacturing' techniques (i.e., drilling, cutting, milling) that remove materials to reveal a finished part, 'additive manufacturing' builds objects layer upon layer from a digital 3D model.

The variety of products that can be 3D-printed is seemingly endless, from engine prototypes and flight-ready aerospace parts, to performance running shoes, bespoke eyewear, hearing aids, and dental aligners. 3D printing is also initiating a new era of precision healthcare and personalized medicine. Patient-specific data can be used with 3D printing techniques to create custom implants and prosthetics. It can also produce more intricate medical models and surgical instruments.

Today's market for 3D printing has evolved to allow designers to create digital 3D models of their products, which can be uploaded to 3D centers for printing. A marketplace is emerging that enables companies and individuals to purchase and download digital designs for on-location 3D printing.

Important Dates in 3D Printing

1860→ The photosculpture method of François Willème captures an object in 3D using cameras surrounding the subject.

1892→ Joseph E. Blanther proposes a layering method to produce 3D topographical maps.

1972→ Matsubara of Mitsubishi Motors proposes to use photo-hardened layers of materials (photopolymers) and stack them together to form a casting mold.

1980→ First patent application for rapid prototyping technology is filed by Dr. Hideo Kodama of Nagoya Municipal Industrial Research Institute, Japan. Dr. Kodama had successfully demonstrated the process for creating 3D plastic parts by photo-hardening polymers with UV exposure.

1984→ Chuck Hull files for patent for stereolithography apparatus (SLA).

1986→ First patent issued to Chuck Hull for "Apparatus for production of three-dimensional objects by stereolithography".

1987→ First commercial rapid prototyping system, the SLA-1, is introduced by 3D Systems.

1989→ Carl Deckard issued patent for selective laser sintering rapid prototyping process, which uses a laser to fuse powder instead of solidifying a plastic as SLA technology did.

1991→ Stratasys produces the world's first fused deposition modeling machine, which uses plastic and an extruder to deposit layers on a print bed.

1992→ Fused deposition modeling patent is issued to Stratasys.

1992→ DTM produces the first selective laser sintering machine.

1994→ First commercialization of ColorJet Printing (CJP).

2002→ A 3D-printed, functioning miniature kidney is produced. Scientists aim to produce full-sized, working organs.

2008→ The first 3D-printed prosthetic leg is produced.

2011→ The first 3D-printed robotic aircraft and car body are produced.

Description of the Landmark

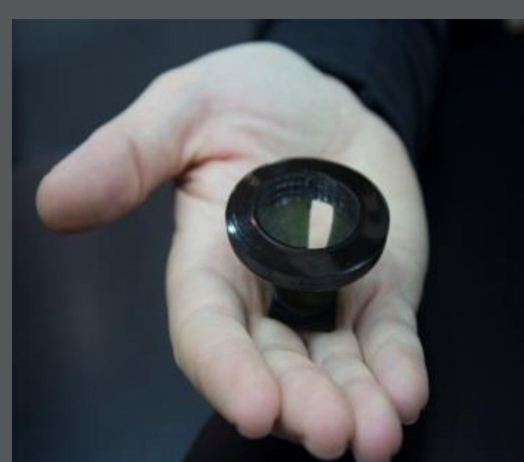
The nominated work, an SLA-1 model from 3D Systems, represents the first generation of commercially available 3D printers. Principal components of the SLA-1 include a container filled with UV-curable liquid (photopolymer), a programmable source of UV light, scanning mirrors to direct the light, a movable elevator platform to support and position the object as required during printing, and a computer to design the 3D object and translate the design into commands for the device to form the object.

In the printing stage, the SLA-1 creates a 3D object by focusing its UV laser into the container with the UV-sensitive photopolymer liquid, which solidifies wherever the laser's beam hits it. The SLA-1's computer controls the elevator, moving the platform upon which the 3D object is made during the printing operation.

The SLA-1's computer also controls the scanning mirrors, which direct the laser beam as it moves over the photopolymer. The laser forms the object to be manufactured ("printed") within the liquid by hardening selected parts of very thin slices, or layers, of the photopolymer. It does this by scanning one layer at a time, forming the object from the bottom up. The remaining liquid is then drained off.

One of the earliest SLA-1 devices is located in the 3D Systems' headquarters in Rock Hill, South Carolina.

SLA-1, the first commercial prototyping device from 3D Systems



First SLA-printed part created in 1983 by Chuck Hull

About the Inventor

Chuck Hull is recognized as the inventor of the solid imaging process known as stereolithography, the first commercial 3D printing technology. With the founding of 3D Systems in 1986, he initiated the 3D printing industry and continues to lead it today as 3D Systems' Chief Technology Officer. He is a named inventor on more than 85 U.S. patents, as well as numerous other patents around the world, in the fields of ion optics and 3D printing.

Mr. Hull's work has earned him many awards and distinctions over his career. In 2014, he was inducted into the National Inventors Hall of Fame at the United States Patent and Trademark Office for inventing and continuing to pioneer 3D printing. The same year, he was the recipient of the European Patent Office's prestigious European Inventor Award in the non-European countries category for his contributions to technological progress and the advancement of society. He also received The Economist's prestigious 2013 Innovation Award, recognizing significant contributions across the fields of science and technology.

Mr. Hull received a Bachelor of Science in Engineering Physics from the University of Colorado in 1961, an honorary Doctorate in Engineering from Loughborough University in the U.K. in 2005, and an honorary Doctorate in Science from the University of Colorado in 2016.

Sources

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Charles "Chuck" Hull

The History and Heritage Program of ASME

Since the invention of the wheel, mechanical innovation has critically influenced the development of civilization and industry as well as public welfare, safety and comfort. Through its History and Heritage program, the American Society of Mechanical Engineers (ASME) encourages public understanding of mechanical engineering, fosters the preservation of this heritage and helps engineers become more involved in all aspects of history.

In 1971 ASME formed a History and Heritage Committee composed of mechanical engineers and historians of technology. This Committee is charged with examining, recording and acknowledging mechanical engineering achievements of particular significance. For further information, please visit http://www.asme.org

Landmark Designations

There are many aspects of ASME's History and Heritage activities, one of which is the landmarks program. Since the History and Heritage Program began, 260 artifacts have been designated throughout the world as historic mechanical engineering landmarks, heritage collections or heritage sites. Each represents a progressive step in the evolution of mechanical engineering and its significance to society in general.

The Landmarks Program illuminates our technological heritage and encourages the preservation of historically important works. It provides an annotated roster for engineers, students, educators, historians and travelers. It also provides reminders of where we have been and where we are going along the divergent paths of discovery.

The American Society of Mechanical Engineers

ASME helps the global engineering community develop solutions to real world challenges. ASME, founded in 1880, is a not-for-profit professional organization that enables collaboration, knowledge sharing and skill development across all engineering disciplines, while promoting the vital role of the engineer in society. ASME codes and standards, publications, conferences, continuing education and professional development programs provide a foundation for advancing technical knowledge and a safer world.

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History of ASME Piedmont-Carolina Section

Organized: As a Branch, 1923, as a Section, 1927; Name from Charlotte Section to Piedmont-Carolina, 1940. Name changed to Piedmont, 1949; Name changed to Piedmont-Carolina, 1949. Headquarters City: Charlotte, North Carolina. Territory: Counties of Iredell, Alexander, Caldwell, Burke, Catawba, Rowan, Montgomery, Stanly, Cabarrus, Mecklenburg, Lincoln, Gaston, Cleveland, Rutherford, Union, Anson, and Richmond in North Carolina; York County in South Carolina.

Acknowledgments

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