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SATRA SPOTLIGHT

The value of 3D printing

Investigating the development of 3D printing and its application in testing and other fields.

Three-dimensional (3D) printing technologies have been around for over 35 years. However, due to a patent expiring in 2009 for one of the most common 3D printing technologies ('fused deposition modelling'), the industry has grown rapidly in the last decade. This has led to advances in technologies, the portability of machines and new materials which, in turn, has opened up a range of applications across multiple industries, including medicine, architecture and aerospace.

Several different 3D printing technologies are available, with the main difference between the most common technologies being the way that the layers of the printed part are built up. These are i) 'fused deposition modelling' (FDM), which melts or softens the materials which are then extruded to produce parts layer-by-layer, ii) 'selective laser sintering' (SLS), which directs a laser beam backwards and forwards over a bed of powder, fusing it into a solid form, and iii) 'stereolithography' (SLA), which uses the process of curing photo-reactive resin with an ultraviolet (UV) laser to convert liquid material into a solid object.

There are a number of advantages in using 3D printing technologies over traditional manufacturing techniques. The lead time from design to production can be very fast, greatly reducing prototype production times. This is particularly the case for components that would otherwise need to be manufactured by a moulding process. Three-dimensional printers can also produce more complex and accurate parts to an exact computer-aided design (CAD). Printing a part can decrease the manufacturing cost, as small quantities can be produced which, in turn, can reduce the number of manufacturing processes. The cost of materials can be slightly higher, but this is counteracted by the decrease in machine operational costs, labour costs and material waste, and the elimination of capital costs for moulds. Three-dimensional printing also gives designers more freedom, as they are not so restricted by traditional manufacturing methods and they are more able to customise each product. Sustainability is one of the most important advantages, as the most common 'subtractive' manufacturing techniques are computer numerical control (CNC) milling and turning, which both remove a significant amount of material – unlike 3D printing, which builds the model from the material. As most of the materials used in 3D printing are untreated, they can be easily recycled.

Applications for 3D printing

3D printing is of high importance to many industries, especially those involved in the medical industry. Implants and prosthetics can be specifically made to suit patients, and models of the patient's organs or other body parts can be produced, which surgeons can use for surgical planning or practice.

3D printing can also help researchers, designers and developers. Simple ideas, which could be originally drawn, can be made into digital designs and then printed in a short period of time. This can save both time and effort, as designers can have a tangible item that can be handled easily – especially if these parts are integrated items that can be assessed for fit. Changing the design is also made easier as it can be edited and reprinted. This type of printing is useful to reverse-engineer parts, especially for older machines or equipment (which may have components that have been discontinued) or for specialised parts that can be used to adapt a current machine to the customer's needs. As 3D printing technologies continue to improve (especially the growing range of materials), industries are finding new ways that 3D printing technology can be applied to their sectors.

3D printing at SATRA

SATRA currently uses two 3D printers. One of these uses FDM technology, which produces shapes made up of multiple layers of 0.25 mm thickness. This system prints on a print area of 203 x 203 x 152 mm, in a durable, engineered, acrylonitrile butadiene styrene (ABS) plastic that can be sanded, drilled or tapped to suit. While the material is not flexible, it can be used to build designs of surprising complexity and detail.

The software used for this printer can also be adjusted to print with either a solid or 'sparse' structure (low or high density), which can vastly reduce the weight and the amount of material used. The printer also deposits layers of 'support' material, which acts as a 'scaffold' to either protect and encase delicate structures during printing, or to fill voids in a structure. This support material can be removed from the finished model by placing it into a wave wash station, which uses a mild alkaline solution to agitate the support material and remove it from all areas on the model.

The second printer uses 'Polyjet' technology, in which drops of photopolymer that solidify into a form when exposed to ultra violet (UV) light, and print at a microscopic layer resolution with an accuracy of 0.1 mm. This system prints on a print area of 300 x 200 x 150 mm in a rigid and opaque photopolymer, in transparent form and a range of colours and hardnesses (from Shore hardness A 30 to 100). The Polyjet printer also uses a simulated polypropylene material that has desirable properties, such as durability and stretchability. This printer has a higher resolution than the ABS version, and it can create very detailed and intricate designs with a smooth gloss or matt finish. Only solid structures can be printed, using a soluble support material which can be easily removed in a clean and contained manner by using a high-pressure cleaning station.

Applications within testing

SATRA's 3D printers are available for contract work and have already been used in a variety of applications in both research and testing. Contract testing work carried out in the innovation and development department can often require one-off prototypes to be built for the purposes of testing unique, non-standard products. The framework for these machines is often made from aluminium bar and pneumatic cylinders. However, they may also contain unusual fittings which will need to be custom made for that specific machine. Three-dimensional printing is ideally suited for this task.

A variety of products are printed at SATRA, including components for a number of internal departments. Such items include the cheek, heel and toe pieces for the SATRA STM 505 dynamic footwear water resistance tester in UK child sizes 8 to 13 and UK adult sizes 1 to 12, which are used to conduct the SATRA TM230:2017 – 'Dynamic footwear water penetration test. Other 3D printed items produced at SATRA include bubble baffles used in our SATRA TM446:2018 – 'Resistance to waterborne abrasive particulates' test, gauges to assist with testing, templates and moulds for testing in SATRA's footwear department, acoustic mounts for our safety product testing department and machine pieces for the SATRA test equipment department.

How can we help?

15 PER CENT DISCOUNT ON FIRST SATRA TEST — please click here.

Please email innovation@satra.com for more information on how SATRA can help you with your 3D printing requirements.

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