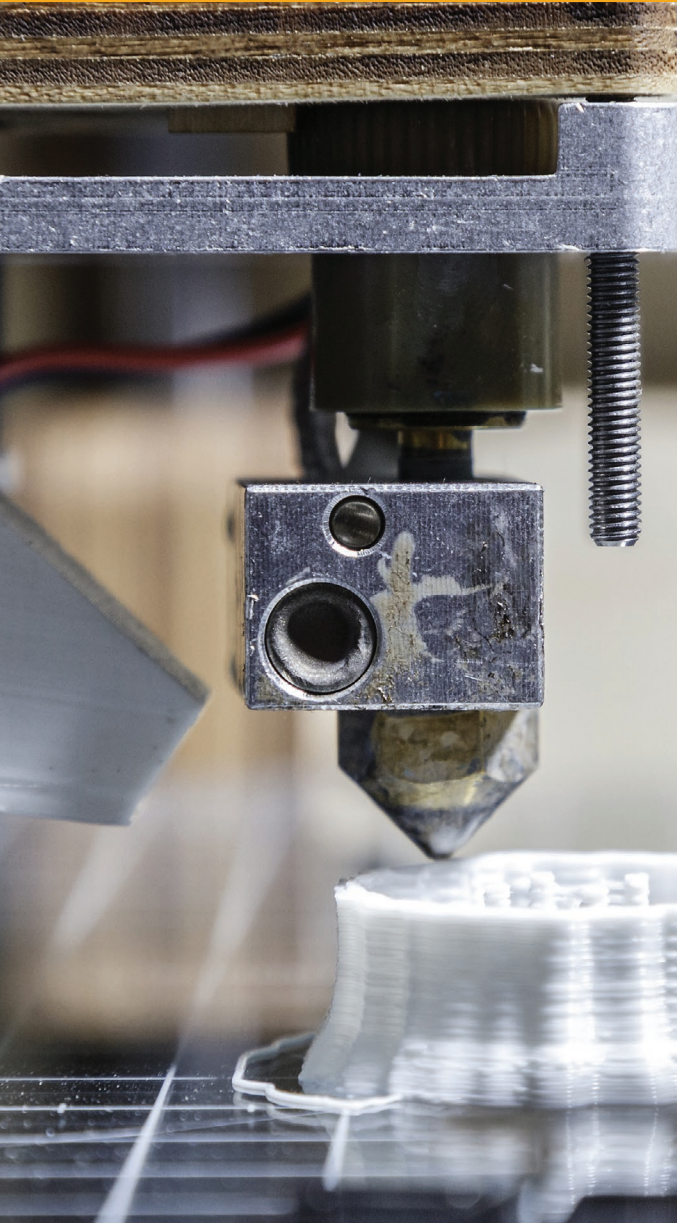


3D PRINTING—A FAST MOVING MARKET



Developments in 3D Printing

A Sector by Sector Overview

Overview

This report explores developments in 3D printing across several sectors and categories for the quarterly period of January to March 2018.



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General

African labs build 3D printers from e-waste

Two labs in African nations have built 3D printers out of e-waste. Staff at WoeLab in Togo, a community tech hub and inventor/entrepreneur network, built a 3D printer in 2013 using parts from old printers, computers and scanners. Since then, they have built 20 more, with a goal of placing a printer in every school within a kilometre of the lab. In Tanzania, students at Buni Hub mini-fabrication lab also built a 3D printer from e-waste. E-waste is a growing problem on the African continent. WoeLab and Buni Hub hope to increasing e-waste recycling while simultaneously creating ways for people to generate income and improve tech access.

HP, 3D Systems partner with SolidWorks to optimize CAD modeling for 3D printing

One partner in both collaborations, Dassault Systèmes SolidWorks CAD platform, is working with HP to optimize SolidWorks by taking advantage of HP's Multi Jet Fusions 3D printing process. Unique to this collaboration is the ability to control part properties at the individual voxel (3D pixel level) - designers will be able to control colors, textures and physical properties, or electrical conductivity that vary in a controlled manner. Separately, 3D Systems launched 3DXpert for SolidWorks software, which will enable users to optimize designs for both plastic and medical additive manufacturing.

Wipro3D launched 3D printing center in India, aims to go global

India-based IT company Wipro's additive manufacturing arm, Wipro3D, launched a metal 3D printing experience center at its HQ in Bengaluru, India. It's the first of its kind in the area, providing existing and potential customers of 3D printing technology a test bed of the latest additive machines and tools. It's the company's first step in its broader effort to go global with Wipro3D.

XYZprinting launches suite of compact, every-day-use printers and pens for families, schools

XYZprinting launched a compact 3D printer, the da Vinci Nano, which it claims lowers two of the main barriers to mass 3D printing - price and ease of use. The printer is aimed at families, schools and other entry-level users. Improvements from the company's earlier model include a mobile app, with the option to wirelessly print from a tablet and, eventually, a phone. While this model includes software, the company plans to launch a microsite with education materials for home and school users sometime in 2018 as well. The company also launched the Davinci 3D Pen Cool, aimed at younger children interested in 3D printing. The Cool is safer than its predecessor as it includes a temperature modifier.

HP sets up 3D printing capabilities in India, sees country as strategic hub for Asia-Pacific region

A year following its global launch, HP is introducing its 3D printing technology solutions in India. It formed partnerships with Mumbai-based Imaginarium and Noida-based Adroitec to sell its solutions in the country. HP believes that India is a strategic hub for the next industrial revolution in the Asia-Pacific and Japanese markets. The company plans to focus its 3D printing solutions in the areas of robots, aerospace, higher education labs, defence, auto and healthcare sectors.

XYZprinting's printer responds to voice command

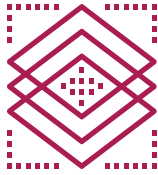
XYZprinting's DaVinci Color Aio color 3D printing allows for voice command. The technology, inspired by other voice services, was developed in-house. While the service is limited at launch, it will eventually allow users to prep their print job, pause, calibrate, get status updates and conduct printer maintenance. Currently a service offered on the one model, the company has not indicated whether it plans to roll it out to other models as of yet.

Italian startup wants to connect 3D printer network with blockchain

Italian startup 3D-Token wants to integrate a network of 3D printer with blockchain technology in what it calls "Network Robots' Workforce," a decentralized network that would not only reduce production cost but act as a catalyst for innovation in 3D manufacturing projects. The company maintains a network of 100 3D printers but aims to increase this number to 3,000 by the end of 2019 with 1,000 Network Members and a production capacity of up to 300 tons of processed bioplastics. In addition, the company is introducing 3DT, a cryptocurrency that can be used for crowdfunding campaigns and be traded within the network. Those holding 3DTs can also benefit from profit sharing from the Network. Regulatory restrictions restrict U.S. residents from buying the cryptocurrency.

Kodak and Twindom launch full body 3D scanner to provide figurines for digital identities

Kodak and California-based Twindom partnered to launch a full body 3D scanner, the KODAK Full Body 3D scanner. Twindom's belief is that eventually everyone will want to have a 3D model of themselves printed, which they can then use as a digital identity for gaming, online shopping, or health and fitness. The scanner, which is mobile, can be set up at retail locations and events where people can be scanned. Their figurines are then shipped directly to their homes.



Materials

N.J.-based scientists successfully 3D print hydrogel, unlocking application for artificial tissue, soft robots

Engineers at Rutgers University in New Jersey successfully created a manufacturing process that produces a 3D printed hydrogel that can change shape in response to temperature. Known as Poly, the gel is used in a number of medical and engineering applications. Traditionally, however, it has been constrained to two-dimensional forms. Scientists have now successfully added a third - and fourth - form. Dubbed the “smart hydrogel,” the gel offers a range of potential applications, including artificial tissue in human bodies and as flexible sensors in robotics.

The Department of Energy discovered how to 3D print structures made of water

The Department successfully printed structures up to several meters long consisting of water inside an oil casing. As part of their experiment, the researchers didn’t use regular water - rather they seeded the water with gold nanoparticles and dispersed polymer ligands. As a result, this created a nanoparticle sheath that prevented it from breaking into droplets, allowing the water to maintain its shape in the tube. The researchers are referring to the combination of the gold nanoparticles and polymer ligands as “nanoparticle supersoap.” This discovery is the first step toward creating liquid electronics, which could then conform to any shape and be placed in stretchable devices.



Printing Techniques & Capabilities

Researchers develop rotational 3D printing method that yields high-performance composites

A team of researchers at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) developed a 3D printing technique that arranges fibers just like nature does, yielding high-performance composites. Their method, referred to as “rotational 3D printing” offers a range of potential applications, from fused filament fabrication to direct ink writing, to large-scale thermoplastic additive manufacture. It also can be used with any filler material, from carbon and glass fibers to metallic or ceramic whiskers and platelets. It will facilitate the ability to create complex microstructures and control the microstructure from region to region.

Harvard researchers develop 3D printing method for embedding sensors in soft robots

Inspired by nature, Harvard University researchers built soft robots that can crawl, swim and grasp delicate objects - they can even assist a beating heart. Up until recently, these robots haven’t been able to respond to the world around them, largely due to the rigid nature of sensors. However, the scientists developed a 3D printing method for creating soft robots with embedded sensors that can sense movement, pressure, touch and temperature. Looking ahead, the researchers plan to power machine learning to train the devices to grasp objects.

Robotic 3D printer uses augmented reality to fabricate designs in real time

The Robotic Modeling Assistant (RoMA) combines augmented reality with robotic modeling to allow users to design primitive 3D models on one side of a platform while the robotic arm produces the object on the other. This technology will also allow designers an opportunity to test direct design and print onto an existing object (i.e., eventually customize existing objects around the home). At present, the benefit of RoMA is that it allows designers to check the physical print at a very early design stage. Scientists hope that eventually the robot will get smarter - not just following instructions from the user but understanding the user's design intention or co-designing alongside the user.

Netherlands-based scientists successfully 3D print living cells

Scientists from the University of Twente, using a new technique called "in-air microfluidics," successfully printed 3D structures with living cells. This technique will support fast and "in-flight" productions of viable micro building blocks that can be used to repair damaged tissue. The technique can capture a living cell inside printable material; it prints bio building blocks in a 3D structure that looks like a sponge, filled with cells and fluid, which have a similar structure to natural tissue.

Researchers create shockwave using 3D printed energetic materials, aim to make them safer

A team of researchers from Purdue University created a shockwave using 3D printed energetic materials, which contain high amounts of stored chemical energy that can be released and are used in anything from airbags to explosives. The team described the project as an effort to improve the precision and safety of energetic materials. Australia's Defence Science and Technology Group is working on a similar mission, to not only make these materials safer but also more effective.

U.K. researchers successfully 3D print drugs

Researchers at the University of Glasgow in the U.K. tailored a 3D printer to synthesize pharmaceuticals and other chemicals from widely available composites, which are then fed into a series of water bottle-sized reactors. This development could digitize chemistry, allowing users to synthesize any compound. The lead researcher, Leroy Cronin, aims to democratize chemistry the way MP3 players did for music. In a recent breakthrough, he successfully printed a series of interconnected reaction vessels that carry out four different chemical reactions involving 12 different steps. By adding different reagents and solvents at various intervals, researchers successfully converted widely available compounds into the muscle relaxant, baclofen. They were also able to produce other medicines, including an anticonvulsant and a drug to fight ulcers and acid reflux.



M&A and Investments

3D Printer startups set industry fundraising records

In analyzing industrial 3D printing deal trends across these segments since 2013, CB Insights found printer startups raised a record 26 deals in 2017, including mega-rounds to Carbon (\$143 million) and Desktop Metal (\$160 million). Deal counts climbed every year since 2013, largely driven by corporate investors. In 2015, printer makers began to gain traction, raising 18 deals, up from just five a year prior. Half were early-stage companies raising seed or Series A deals, several of which maintained momentum to exit through M&A or raise much larger rounds.

SD3D buys materials research company 3D Matter

SD3D acquired New York-based software company, 3D Matter. The deal includes both the 3D Matter brand and the Optimatter material optimization software – a platform in which designers, engineers and researchers can optimize their 3D printed parts by ensuring the right materials and processing parameters are chosen for the specific part application. The service is offered to users as a monthly subscription.

Sandvik Mining invests \$25M to build metal 3D printing plant

Swedish equipment and tool manufacturer Sandvik Mining invested about \$25 million in a titanium and nickel metal powder plant to strengthen its 3D printing prowess. The facility will be in Sandviken, Sweden, near an in-house titanium raw material supply and 3D printing center. It's expected to be operational in 2020.

Bosch invests in Ultimaker 3D printers to cut costs, increase innovation

Bosch is investing in Ultimaker 3D printers to drive innovation while cutting manufacturing and design costs. Ultimaker 3 Extended printers will now be used in Bosch locations across Germany, Hungary, China, India, the U.S. and Mexico for printing prototypes, tooling, jigs and fixtures.

Siemens invests \$37.89M for U.K. 3D printing factory

Siemens' investment in the state-of-the-art 3D printing factory for Worcester-based Materials Solutions Ltd will enable it to increase its fleet of 3D printing machines from 15 to 50 over the next five years. The factory is set to open in Sept. 2018. Siemens acquired a majority stake in Materials Solutions in 2016. The business uses Selective Laser Melting (SLM) technology in manufacturing high-performance metal parts and has grown its business considerably over the last two years.

Mitsubishi Chemical acquires Dutch 3D printing manufacturer

Mitsubishi Chemical Performance Polymers Europe acquired Dutch Filaments, a manufacturer of 3D printing filaments in Europe. Dutch Filaments, which employs 70 at a facility in the Netherlands, will strengthen Mitsubishi Chemical's position as a supplier of 3D printing materials.

Fuji's Xerox takeover will make it a 3D printing power

Fujifilm's acquisition of Xerox's printing business is bringing together three uniquely distinct 3D printing business lines and R&D programs including Fujifilm's, Xerox's and that of the Fuji Xerox joint venture. This comes as more businesses, designers and manufacturers are utilizing 3D printers to either create new or improved products or self-manufacture a previously supplied component by a third party. Despite Fujifilm's specialization in a wide array of areas related to 3D printing, manufacturing 3D printers isn't one of them. Over the last few years, Xerox has made several investments to explore 3D printing possibilities. Some of the experiments involved the utilization of flexible, conformal image sensors and detector arrays for medical imaging and security applications, smart inks adding electronic functions to automotive or wearable devices and even electronics that can configure themselves from microchip inks. The integration of Xerox's developing printed electronics and sensors into 3D printers converts a static 3D printer into a smart 3D printed final product.

Beamler acquires startup Printr to offer accessible 3D printing software

3D printing software company Beamler acquired Netherlands-based startup Printr. The company sought to make 3D printing more accessible by developing The Element, a box that connects to a 3D printer and contains all the necessary software to solve the issue. As part of the acquisition, Printr will be integrated with Beamler to enhance both firms' offerings.

Carpenter acquires CalRAM, continues 3D printing M&A push

U.S.-based Carpenter Technology Corporation acquired CalRAM, a specialist in powder-bed fusion additive manufacturing technologies. These powders and wires are feedstock for metal additive manufacturing operations that produce jet-engine fuel nozzles, rocket-thrust chambers and orthopedic implants. Carpenter, a producer of specialty alloys and metal powders, which acquired Titanium powder producer Puris last year, continues to invest in 3D printing following strong results in Q2 2018. The firm's CEO [says](#) it will accelerate investment into additive manufacturing and soft magnetics.

Ford leads investment in 3D print startup Desktop Metal

Ford is leading a \$65-million investment in Desktop Metal. The startup's 3D printing systems, which come in two sizes, can rapidly churn out finished parts of steel, aluminum or many other alloys. Desktop Metal's 3D printers bind metal and ceramic powders into a soft polymer, emitting layers of this mixture to make an object, which is moved into a sintering furnace. The polymer burns off inside the furnace, and the metal fuses together without losing its shape. The resulting pieces are comparable to cast metal parts in terms of structural integrity. Along with the investment, Ford's Chief Technology Officer Ken Washington joined Desktop Metal's board of directors. While Ford isn't using Desktop Metal printers for vehicle production lines yet, he said the companies are working to make this a possibility.

GE takes controlling stake in 3D printing firm Arcam

GE's \$1.4-billion acquisition of a controlling stake in Swedish 3D printing company Arcam is another major addition to its portfolio. GE also plans to delist the company, which makes electron beam melting equipment, from Nasdaq. GE originally announced the acquisition in 2016, along with a bid for SLM Solutions Group that was ultimately rejected. Technology from both companies is used in GE's jet engine operation.

3D-printed rocket company Relativity Space brings in \$35M Series B round

3D printing company Relativity Space received a very large cash infusion to support its efforts to 3D print its rocket engines and boosters. The company brought in \$35 million in a Series B funding round, which it says will be used to attract launch contracts for future constellations of satellites. The company already secured more than \$1 billion in commitments for future orders, provided it can become operational within a reasonable time frame.



Patents & Copyright

Just 3D Print suing 3DR Holdings for defamation again

After losing the initial legal battle against 3DR Holdings over defamation allegations, Just 3D Print is taking the company back to court in a new appeal. The controversy began after it was reported that the startup downloaded various 3D models from Thingiverse and was selling them on eBay. Back in 2016, a Thingiverse user discovered that an eBay storefront called Just 3D Print was selling one of her models without respecting the Creative Commons license attached. It was then discovered Just 3D Print downloaded hundreds of models from Thingiverse and was selling them as printables on eBay. After a lengthy back and forth, eBay eventually closed down the shop and that was that, however the startup felt that some of the coverage was defamatory, therefore it ended up taking three different parties to court: Stratasys (which owns MakerBot and in turn Thingiverse), TechCrunch and 3DR Holdings. Although victorious in the case against Stratasys, Just 3D Print ended up losing to both TechCrunch and 3DR Holdings because the plaintiff failed to prove that the media company's actions were related to any harm experienced by Just 3D Print.

Apple full color 3D printer a possible 'breakthrough'

Apple won a patent for a full-color 3D printing system, whereby the printed object is first made and then colored in afterwards. Having a separate print head that adds color strengthens the object and can add additional functionality like conductivity. The development is being viewed as a breakthrough in expanding 3D printing. While there's been no announcement about an Apple 3D printer under development, the granting of a patent means Apple will be able to manufacture a system if it so chooses.

Amazon wins patent for on-demand, pickup or delivery 3D printing

Amazon won a [patent](#) for a retailing system that can take custom orders for 3D printed items and have them sent out for delivery or picked up by the customer. The system has been the subject of multiple patent applications over the past five years: Amazon set up an online store for custom 3D printing back in 2014, but that part of the website currently offers only 3D printing hardware and supplies.

Nikon files patent for 3D printer with porosity inspection feature

Nikon was approved for a patent application for a new type of 3D printer, which includes a feature giving Nikon the ability to correct its own mistakes. 3Dprint.com [reported](#) that the patent includes an inspecting unit, which would examine the print's layers to spot holes or rough surfaces, and would then fill in any holes, or take action to ensure the subsequent layer still adhered to the rough surface. Porosity is one of the biggest problems in powder-based 3D printing, therefore a printer that can repair that issue as well as other surface imperfections would be a gamechanger.

**Auto****Hackrod seeks to 3D print people's car designs**

A start-up wants its customers to do the designing while it uses 3D printers to bring it to life. [Hackrod](#) envisions prototypes created in partnership with customers, or “co-creators.” The consumers will be able to select their own custom options while an intelligent digital platform sources components, engineering and other hardware.

Polymaker and XEV launch first mass-producible 3D-printed car

Polymaker, a Shanghai-based 3D printing material company, and XEV, an Italian electric car company, launched the first mass-producible 3D-printed electric car in Shanghai in March. XEV partnered with Polymaker to generate material solutions and post-processing options that helped bring 3D printing into mainstream automobile production. The new car, named LSEV, weighs only 450 kg and contains only 57 plastic parts, compared to the more than 2,000 that comprise similarly sized vehicles. Apart from the LSEV's chassis, seats, and glass, all visible car parts are made through 3D printing, leading to a 70% reduction in investment costs. XEV plans to start mass production of LSEV during the second quarter of 2019. It has already received two major orders for the new car: Poste Italiane has order 5,000 vehicles, while ARVAL, a European vehicle leasing company, has ordered 2,000.

3D printing Repair Bot will fix previously non-repairable car parts

Swinburne University of Technology is partnering with the Innovative Manufacturing Cooperative Research Centre and Tradiebot Industries to develop a project called Repair Bot. The project – an automated repair service for plastic car parts – will use 3D printing, robotics and advanced materials. Its goal is to reduce the need to spend money and materials on replacement car parts, by enabling robots to repair previously non-repairable, complex design elements. The project will use new polymers and will focus on plastic trim and assembly components. Repair Bot has garnered more than \$1.2 million in funding so far, with research to be undertaken through 2018 and 2019.

Luxury concept car features 3D printed interior

At the New York International Auto Show, luxury automotive brand Genesis showcased its Essentia concept car. The car features a customized interior enabled by 3D printing. Essentia is the first electric vehicle by Hyundai subsidiary Genesis. Its 3D printed interior is designed to increase the connection between driver and car by focusing on details, eliminating extraneous elements and displaying a transparent cockpit cell. 3D printed webbing connects the car's interior and exterior. While Essentia is only a concept car, Genesis says it will eventually bring a luxury/performance vehicle to market.

Ability to 3D print syntactic foam has application for submarine manufacturing

Researchers have created a new process that uses 3D printing to create components of syntactic foam – a strong but lightweight composite used in vehicles, airplanes and ships. This breakthrough is specifically notable for its potential in submarine use. It would allow manufacturers to print components with complex shapes that can survive the stress of deep waters.

Porsche approves 3D printing to replace parts for rare, classic cars

Porsche is 3D printing spare parts for rare and classic cars using a combination of SLM 3D printing for metal parts and SLS 3D printing for plastic parts and tooling. The car company added numerous spare parts to its catalog, ensuring its cars will drive on for longer. Porsche tested a 3D printed spare parts initiative with the discontinued release lever for the clutch on the Porsche 959. The SLM 3D printed lever met the requirements of the original component and the company has since introduced eight additional plastic parts to its digital spare parts library including a filler cap, a crank arm and a brake part. A further 20 parts are planned for the immediate future as a pilot run.

Bugatti produces world's first caliper using 3D printing

According to Bugatti, it created the world's first caliper using 3D printing and it's made from titanium. Furthermore, Bugatti says it's the largest 3D-printed component ever made from such a material. The project was an attempt by Bugatti to show its usefulness as an R&D hub for its parent company, the Volkswagen Group.

Wave of the Future 3D, Sask. Polytechnic build camper-trailer using large-scale 3D printer

A full-sized, 3D-printed camper-trailer took just over 230 hours to complete with a special 3D printer at Create Cafe through a partnership between Wave of the Future 3D and Saskatchewan Polytechnic. Despite a few problems during the process, including an unexpected software reboot, the team felt the process went fairly smooth for a prototype print. The camper is 13 feet long, over six feet wide, weighing 600 pounds and it has a 100-year life expectancy. The trailer still needs to be fitted with appliances, electronics, and windows.

MINI owners may custom create 3D printed parts for their vehicles

A MINI customization service will allow owners to design and 3D print their own parts. The [MINI Yours Customized](#) is an online design tool whereby customers can select different parts and pieces available for customizing. They can choose parts like side panels, interior trims and door sills and fashion them with colours, finishes and illustrations, and even add their name. Owners are able to install the add-ons themselves or can ask their dealer. If the car is later being resold, the parts can be removed just as easily and to revert to its original design.



Aviation & Aerospace

Metro Aerospace, 3D Systems launch 3D printed parts for aerospace fuel efficiency

3D Systems' On Demand manufacturing team helped Metro Aerospace take their microvanes - a drag-reduction and performance enhancement technology - from a prototype into a production part. Delivered in ship sets of 20, the 3D printed microvanes are each about 10 inches long and each one different. Metro Aerospace said they can reduce total drag by approximately 15 points. The company further indicates that their incorporation can lower fuel consumption by approximately 25 to 30 gallons per hour while also providing significant reduction on inboard engine wear.

Finnish company 3D prints first plane component

Finland's Patria has 3D printed the country's first aircraft engine part, installed in the F/A-18 Hornet strike-fighter, which went on its successful maiden flight earlier this year. It was fabricated using the nickel-based Inconel 625 superalloy and was used before to manufacture turbine blades.

Aviation, communications companies share 3D printing aspirations

Thales Group's 3D printing plant in Morocco is developing parts for Thales Alenia Space, however the company is investing in additive manufacturing for in-house parts used in aerospace. Thales said it ultimately aspires to create a 3D metallic printing production chain that meets both internal and external. Satellite operator and Ka-band inflight connectivity provider ViaSat is also keen on 3D printing. It's eyeing to make phased array antennas commercially viable for its residential and ultimately aero connectivity customers.

Roush acquires largest, most powerful 3D printer

Michigan-based Roush is the first in North America to install the Concept Laser Xline 2000R - the largest powder bed metal additive manufacturing system of its kind. This will expand its additive manufacturing capabilities to accommodate multiple industries, including aerospace, automotive, defense, energy, entertainment, medical and consumer products. With the printer, manufacturers can print large amount of small parts, and much larger, individual parts, such as structural components or engine combustion and propulsion components, without using conventional production design restrictions. One of Roush's projects includes additively manufacturing engine components for an undisclosed aerospace cryogenic propulsion system.

Honeywell Aerospace hires Sintavia to 3D print parts using powder bed fusion

Metal additive manufacturing company Sintavia was approved to manufacture components for Honeywell Aerospace using powder bed fusion. Honeywell Aerospace, which previously approved 3D printing contracts with Sigma Labs and 3D Systems, signed with Sintavia following an 18-month qualification process. The approval covers parts including gas turbine auxiliary power units (APUs), turboshaft engines, turbofan engines and engine control valves.

GE Aviation 3D printing factory makes turbine blades for Boeing's largest jet

Avio Aero's 3D-printing factory in Italy is manufacturing 3D-printed turbine blades for the GE9X, the world's largest jet engine, which took its maiden flight last month. GE Aviation acquired Avio Aero in 2013 and developed the GE9X engine for Boeing's next-generation 777X jets. The 3D-printed blades spin inside the engine at 2,500 times per minute. The printing factory holds 20 large 3D printers – a single machine can simultaneously print six turbine blades directly from a computer file by using a 3-kilowatt electron beam. The beam makes the blades by welding together thin layers of titanium aluminide powder – a heat-resistant material, also known as TiAl – which is preferred by jet engine designers. It weighs 50% less than the metal alloys typically used in aviation.

STELIA Aerospace, partners demonstrate metallic self-reinforced fuselage panels manufactured by 3D printing

STELIA Aerospace, Constellium, Centrale Nantes and CT Ingénierie collaborated on the project DEFACTO (DEveloppement de la FABrication Additive pour Composant TOpologique), which used 3D printing technology to eliminate current added stiffeners, which are attached to the fuselage panels with fixing screws and sometimes welding. The project uses metallic self-reinforced fuselage panels with stiffeners directly manufactured on the surface. It was manufactured by a robotic tool, through the deposit of aluminium wire merged by electric arc.

Moog, ST Aerospace team up on 3D printing-enabled digital transactions using blockchain

Moog and ST Aerospace partnered to explore and develop capabilities for a smart digital supply chain for aerospace using 3D printing. They will 3D print aircraft parts leveraging Moog's VeriPart supply chain solution and ST Aerospace's capabilities in 3D printing design, fabrication and certification. The companies seek to improve the supply chain within military and commercial aerospace markets, while meeting trade compliance regulations. Additionally, they successfully conducted a trial to demonstrate the value of a total digital transaction.

Boeing, Oerlikon collaborate on 3D-printed titanium aerospace parts, processes

Boeing and Oerlikon signed a five-year partnership to develop standard materials and processes for metal-based 3D printing. The companies said this will enable the development of a range of safe, reliable and cost-effective structural titanium aerospace components. The collaboration will initially focus on industrializing titanium powder bed fusion and ensuring parts meet the flight requirements of the Federal Aviation Administration and Department of Defence. The companies will seek to identify challenges to qualify materials and processes for aerospace, as well as a way to adopt 3D printing with a qualified supply chain in the market that achieves quality and cost targets.

3D-printed engine part tests successfully for NASA rocket

NASA is undertaking a series of tests with parts made using 3D printing, among other techniques, which will make building future engines more affordable. It tested a 3D printed flight controller on a flight engine that will be used in the Space Launch System (SLS), NASA's new deep-space rocket. It is used as a "brain" and aims to beef up the RS-25 engines and provide the additional power needed by the larger SLS rocket.



Health & Life Sciences

3D-printed bone scaffolds speed healing of cranial defects in rats

Researchers at the University of Texas at Arlington, in collaboration with Texas A&M University, are pursuing the commercialization and scientific development of in-situ, 3D-printed bone scaffold substitutes. Dr. Venu Varanasi of U of T's Bone-Muscle Group has been testing nanobiosilica-based 3D scaffolds to improve bone-healing capability. He hopes his work will one day be used to treat certain types of bone defects "like they are dental fillings" – capable of being managed as out-patient procedures and thus shortening medical stays and reducing expenses. The 3D-printed scaffolds replace traditional metal or plastic implants that can take a long time to be customized and which take longer than desired to support bone healing. Dr. Varansi's study tested the scaffolds on cranial defects in rats. It found that 3D, in-situ, bone-regenerating scaffolds promoted much greater rates of healing than did scaffolds made of traditional materials. Dr. Varansi is now working on helping to bring this technology to human patients.

Materialise and De Puy Synthes expand range of patient-specific 3D printed surgical guides

Materialise launched a new system that will allow surgeons to plan, design and order patient-specific 3D-printed surgical guides for shoulder operations. The TRUMATCH Personalized Solutions Shoulder System forms part of Materialise's partnership with DePuy Synthes, which will distribute TRUMATCH in North America, Europe, Australia and New Zealand. Using CT-scan images, Materialise generates a 3D model of a patient's shoulder which can be accessed through its online platform. Surgeons may also order a 3D-printed model, which allows them to plan and prepare for challenging shoulder surgeries in which incisions are small and visibility is limited. Materialise also offers patient-specific 3D-printed guides for hips, knees and osteotomies.

BioMimics offers more accurate organ models

Stratasys introduced BioMimics, a suite of proprietary software and 3D printing solutions that creates artificial, 3D-printed models of organs and bone with properties nearly identical to the real thing. The company uses new printing materials and its PolyJet 3D printers to move beyond more typical rigid plastics. It has also focused on developing software that permits a higher level of customization and complexity, thus more precisely reflecting patient anatomy using data from CT or MRI scans. The new software additionally permits the construction of more intricate models. Stratasys currently offers BioMimics as a service, but plans to eventually release a specialized commercial 3D printer capable of printing organ models.

New 3D printing technique may permit the development of replacement organs

Researchers at Imperial College London have developed a new 3D printing technique that could one day be used to facilitate tissue regeneration and the development of replacement organs. The researchers found that rapidly cooling and freezing hydrogel ink as it is extruded by a 3D printer, and then thawing it, produced a gel that is as soft as body tissues but that doesn't collapse under its own weight. The gel's softness mimics the mechanical properties of organs, which means the could be used in medical procedures to form scaffolds to act as templates for tissue regeneration. The researchers tested the gel's utility by building porous scaffolds and "seeding" them with cells, which successfully attached to the scaffolds, grew and survived. The success of this research, which builds on previous work, could lead to the ability to grow stem cells. The technique could also be used to generate replica organs or other body parts. These could be used in medical training, or permit scientists to carry out experiments not possible with live subjects.

UK surgeons use bespoke 3D-printed implant to repair chest defect

Surgeons in the UK rebuilt a man's chest with a bespoke, 3D-printed implant following surgery to remove a large tumor. To excise the tennis-ball-sized chest tumor, doctors had to first remove three of the man's ribs and half his breastbone. Traditionally, a cement prosthesis to correct the new chest defect would have been prepared during the surgery. This process, however, takes about 90 minutes. Given the man's other health issues, doctors wished to minimize operating time. A titanium rib and breastbone implant was 3D printed ahead of time based on a design by the man's cardiothoracic surgeon.

FDA releases guidance for 3D printer manufacturers

The Food and Drug Administration (FDA) released detailed guidance for 3D printer manufacturers in preparation for a significant wave of new technologies that are expected to transform the medical practice. These include bioprinting and custom-printed pharmaceuticals. The FDA is looking to chart a "more comprehensive regulatory pathway" to keep pace with 3D printing advancements. Its new guidance aims to offer manufacturers safe and effective methods for testing the quality of new printing systems. The guidance, however, is a first step in standardizing approaches to 3D printing in healthcare. The agency expects to develop more robust regulatory frameworks over time.

Drawbacks and benefits of 3D printing at Cleveland Clinic Innovations

A panel of experts at Cleveland's Advanced Design and Manufacturing Expo contend that although 3D printing could become more important in healthcare, it is of more use in developing custom implants than in mass production. Peter O'Neill, executive director of Cleveland Clinic Innovations, noted that 3D printing is not yet cost competitive with traditional manufacturing processes. However, he also noted that Cleveland Clinic Innovations currently uses 3D printing to develop stents used to help patients' breathing. These stents are usually made with a one-size-fits-all approach; 3D printing customized stents has proven more efficient.

Rapid Shape introduces new line of hearing aid printers

Germany-based 3D printer manufacturer, Rapid Shape, introduced a new line of 3D printers for the manufacture of hearing aids. The three printer models can produce professional and biocompatible hearing aid parts quickly, and can facilitate in-house production at a shop level. In addition to hearing aids, Rapid Shape also works on digital dentistry, and on advancing 3D printing technology for the dental industry.

Stratasys JV to focus on mass producing 3D-printed prosthetic arms

Stratasys and Dassault Systèmes have partnered with start-up Unlimited Tomorrow to produce 3D printed, robotic prosthetic arms. Using a scanner attached to an iPad, Unlimited Tomorrow scans a customer's good arm, then uses software incorporating AI to 3D print a matching prosthetic. Stratasys' printers enable the selection of compatible skin tones and even the replication of blemishes. The printed prosthetics cost a fraction of traditionally manufactured ones, and can be produced in a single day. The joint venture between the three companies will focus on refining the design for mass production. As part of this effort, Stratasys will print 100 arms at no cost over the next two years.

Ultra-thin fibers make 3D printing of microscale structures possible; could lead to human tissue repair

Swiss researchers have developed an ultra-thin optical fiber that could permit 3D printers to print micro- or nano-scale 3D structures. Such structures, if made of biocompatible materials, could be printed endoscopically inside the human body, and be used to facilitate the adhesion and growth of cells to repair damaged tissue. The optical-fiber-based technique also makes it possible to print delicate details onto larger parts, so the fibers could become useful add-ons to 3D printers that are already commercially available.

Nanoscribe helps with studies of medical uses of 3D-printed micro-objects

3D printer manufacturer Nanoscribe recently helped with two studies that highlight how 3D-printed micro-objects may be used to create tiny medical devices to enable healing. In the first study, researchers at the University of Iowa developed a new approach for creating ocular tissue. They employed 3D printed polymer scaffolds, which provide structural support for cells so they can grow and reproduce. This work could help researchers develop a treatment for patients with late-stage neurodegeneration. In the second study, researchers at Boston University created a 3D-printed nerve interface, or nanoclip, to stimulate nerve activity. The nanoclip was transplanted into a zebra finch, where researchers used it to track stimulation-evoked nerve responses. The ability to interface with small nerves makes the nanoclip a promising tool for future use in disease treatment.



Manufacturing & Construction

Stratasys's new metal 3D printing platform offers solution for short-run production needs

Stratasys is developing a new metal 3D printing platform for short-run manufacturing. The platform, which has been in development for several years, is based on the company's proprietary jetting technology. Stratasys believes it will offer customers across a number of industries - automotive, aerospace, defense, machining and metal foundries - a solution for short-run production of metal parts with commonly used powder metallurgy, starting with aluminum.

Chinese company 3D prints bus shelter; has plans to build a town

WinSun Construction 3D printed a bus shelter in Jinshan, China. The shelter's unusual shape was made possible by the additive manufacturing process. It's built out of recycled waste material and was constructed in a single night. WinSun previously manufactured a 3D-printed restroom. The company has plans to participate in the construction of an ecologically-friendly small town that will incorporate 3D printing.

Austin startup unveils 3D-printed house at SXSW

Austin, TX-based startup ICON unveiled its new 3D-printed house at SXSW in March. The single-story, 650-square-foot cement house can be printed in 12 to 24 hours. Using a Vulcan printer, ICON can currently print a house for \$10,000, but plans to bring this cost down to \$4,000. ICON aims to use its product to combat the lack of housing facing 1.2 billion people worldwide. In partnership with New Story, a non-profit working on international housing solutions, ICON will construct a community of 100 3D-printed homes for residents of El Salvador in 2019. It plans eventually to build home in the U.S.

Amsterdam bridge will be world's largest 3D-printed metal structure once complete

Amsterdam-based MX3D is using 3D printing to construct a 12-metre-long stainless steel bridge over one of the city's canals. The project has posed a number of challenges to its developers, leading them to change materials, adapt standard 3D printing approaches, create bespoke software and develop different printing strategies for different bridge components. Given the project's novelty, its engineers are not sure whether the bridge will remain structurally sound over time. They are therefore incorporating a number of sensors to monitor its performance according to several metrics. Once complete, the bridge will be the largest 3D printed metal structure in the world.



Clothing & Wearables

3D printing and Swiss luxury watches

Luxury watchmakers are embracing 3D printing to improve efficiency, create new designs, produce prototypes, run mechanical simulations and manufacture specialized watchmaking tools. 3D modeling and printing allows designers to work with shapes that weren't possible to create with milling machines. Some watchmakers are also using 3D printing in watch production: Parmigiani has included some 3D-printed parts in its luxury watches, replacing parts crafted by milling machines. Other watchmakers are expected to follow. In contrast, some watchmakers are resisting the adoption of 3D printing, staking their brand's distinctiveness on claims for machine-made or handmade parts.

GlassesUSA.com releases 3D-printed glasses files, templates

GlassesUSA.com launched 3D printable glasses, as well as files and 3D templates offered to consumers free, allowing them to make their own frames at home. The users can choose from three templates and can add text to the frame designs. The first test models of the glasses were 3D printed by Sinterit on their Lisa desktop SLS 3D printer.

Experts: 3D printed clothing at home is in our future

Experts say there will come a day when consumers can print out customized garments in stores, or even from 3D printers in their own homes. If convenience and customization are potential advantages of 3D-printed apparel, so too is recyclability. Experts say 3D-printed clothes can simply be dumped into blender like machines that turn the plastics into powder and can then be used to print out something new. However, barriers include cost and the comfort of materials. Even the smallest home 3D printers run several hundred dollars, therefore a printer capable of printing human-sized apparel is beyond most individual consumers' reach. Since the printing material is made of plastic, 3D-printed fabric tends to be stiffer and less comfortable than traditional fabric. 3D-printed clothing doesn't yet make sense for everyday use says Elizabeth Esponnette, co-founder of the San Francisco-based on-demand clothing startup Unspun. Though printing out clothing in homes could be decades away, 3D-printed shoes are likely to become common in the next 10 years due to work being done by adidas, Nike and more, and the smaller size of shoes.

3D-printed adidas sneakers launch, exec joins Carbon's board of directors

adidas released their Futurecraft 4D shoes with midsoles made using Carbon's Digital Light Synthesis technology, using light and oxygen. The partially 3D-printed shoes, which feature 20,000 struts, are marketed as the 'ultimate running shoe for all'. Additionally, adidas' executive board member Eric Liedtke [joined](#) Carbon's board of directors.

MIT 3D printing technique includes dye that changes colors

MIT CSAIL's new 3D printing technique ColorFab allows a user to create objects like jewelry and phone cases that can change colors after they're printed. ColorFab's magic lies in the team's custom-made ink, which has base dyes and light-adaptable or "photochromic" dyes. The light-adaptable dyes bring out the color in the base dyes when exposed to UV light. Under visible light, the colors disappear and the ink turns transparent. Once the method has been refined further, the researchers might adapt it for use by the garment industry. Their ultimate goal is to lessen the waste humans produce.

Designer 3D prints children's protective mask using Sinterit Lisa and Autodesk Netfabb

3D designer Bartłomiej Gaczorek created a 3D printed an anti-pollution children's face mask from scratch. He did this by working with desktop SLS 3D printer manufacturer Sinterit, using its Lisa 3D printer and Autodesk Netfabb 3D printing software to create a low-weight mask. The desktop SLS Lisa can manufacture both flexible and durable components, so rigid parts of the mask and its anatomically adjustable face section could both be printed on the same machine. The mask is meant to provide respiratory protection during children's activities like gluing and painting, as well as in areas of high air pollution.

Chanel 3D prints first mascara brush, product to release this year

Chanel has developed the world's first 3D-printed mascara brush to be produced and marketed on an industrial scale. Chanel Parfums Beauté and partner Erpro 3D Factory have been working on the 3D-printed brush for over a decade now and have officially debuted Le Révolution Volume mascara. Fabricating the brush via 3D printing introduces flexibility to the production process, as Chanel was able to manufacture as many inexpensive prototypes as needed in order to test out and determine the best brush formula. Erpro production line with Chanel has six 3D printers, which can produce 50,000 brushes per day. Le Révolution Volume mascara brush will be available in Canada beginning in fall 2018.

Dutch designer uses 3D printing to create one-of-a-kind dresses

Dutch designer Iris van Herpen combines traditional fashion design with technologies that include 3D printing to produce one-of-a-kind, hand-stitched dresses. She collaborates with other creatives in multiple disciplines to produce her work, such as Julia Koerner, and partners as well with 3D printing companies such as Materialise and 3D Systems. *Time* magazine named her 3D-printed dress, "Escapism," one of its 50 Best Inventions in 2011. In 2014, one of her dresses was featured in *National Geographic*, in a piece outlining significant ways 3D printing is being employed across industries. Celebrities such as Beyoncé, Lady Gaga and Bjork have worn her work. An exhibition of van Herpen's work called "Transforming Fashion" concluded its North American tour earlier this year.



Consumer Goods & Retail

Fittle produces 3D-printed puzzles to teach braille

Fittle - a collaboration between Indian designer Tania Jain, LVPEI (India's leading eye institute), Ravensburger and Serviceplan - is producing 3D-printed puzzles designed to help users learn braille. Each puzzle piece has a single braille letter on it. When a puzzle is complete, the letters spell out a word. The completed puzzle itself forms the shape of the object the word describes. Currently available puzzles spell and are shaped as "fish," "mouse," and "rocket." Fittle plans to continue to introduce new shapes. A major advantage to using the puzzles is their low cost compared to other tools for learning braille: four digital braille readers would cost \$10,000. The same amount can purchase 16,000 3D-printed puzzles plus a 3D printer.

3D printed chairs debuted, made from one line of plastic

Design brand Nagami collaborated with other designers on a collection of 3D printed chairs that were shown during Milan Design Week 2018. UCL's Design Computation Lab is one of the institutions that is conducting research 3D printing use in furniture design. It created a chair made from a single line of printed plastic which is more than a mile and a half long.

Incase to use Carbon 3D printers for mobile device case fabrication

Incase partnered with Carbon to use its Digital Light Synthesis 3D printing technology in the development of their products, mobile device cases. Incase will adopt Carbon's algorithm-based design and simulation software which uses diamond-like lattice structures to create shapes meant to absorb achieve maximum impact and drop protection in the lightest frame possible. Additionally, it will have access to 20 Carbon M2 printers and programmable UV-curable resins.

Enthusiast divulges design files for 3D-printed radio using crystal receiver

Texas-based 3D-printing and electronics enthusiast Sage Hansen created a 3D-printed radio and uploaded the 'how-to' files online to share how it's done. It combines old technology - a crystal radio receiver used to produce sound. He used his 3D modeling software to design a form that presents the components in a way that makes it easy for a user to follow the circuit and understand how it works.



Education

3D printing creates new learning and employment opportunities for visually impaired students

3D printing has enormous potential as an assistive technology for visually impaired students, permitting them to better grasp scientific concepts through touch and to move independently through 3D “mapped” spaces. Lizabeth Arum, a former special-needs teacher, considers the 3D-printing education revolution part of the “maker’s movement.” Via access to 3D printing, disabled students become designers and producers of assistive technology, rather than solely consumers. The benefits of access to 3D-printing technologies for visually impaired students may extend to finding employment: one of the most in-demand tech skills is 3D printing. Despite these benefits, however, access to 3D printing remains a challenge for many students and schools.

3D printing helps special needs students, creates positive change

Philadelphia-based artist, designer and educator Christopher Sweeney describes the inspiration and process by which he encouraged his Interpretive Design students to undertake a class project. The project involved designing and building a 3D-printed prosthetic for Sara, a young girl with cerebral palsy who had never been able to draw unaided. After Sara successfully used the prosthetic, Sweeney and Sara’s art teacher, Laura Roth, presented the project at the Pennsylvania Art Education Association Convention, showing the art and design community how 3D printing and collaboration can help special needs students. They also demonstrated that the technology can create grassroots, DIY change via collaboration among different schools, communities and age groups.

SHINING 3D and PrintLab launch new education products

Chinese company SHINING 3D is a developer and manufacturer of 3D digitizing and printing technologies. In January, it introduced two education packages designed to work with its desktop EinScan 3D scanner and Einstart desktop 3D printer: EinScan Discovery Pack and EinScan HD Prime Pack. SHINING 3D, along with its resellers, has also been developing a range of curricula to accompany its 3D printing software and hardware. Its global Master reseller, PrintLab, recently launched PrintLab Classroom, a lesson plan portal for teachers who wish to add 3D printing to their STEM and arts curricula. Teachers or schools can purchase PrintLab “bundles” that include not only lesson plans but also SHINING 3D hardware and software.

GE adds subsidy option to educational program, GE Additive

GE is investing \$10 million worldwide over five years to deliver polymer 3D printers to primary and secondary schools, and metal 3D printers to colleges and universities. The company's educational program, GE Additive, is now in its second year. For 2018, the program added a subsidy option: any organization or individual can apply for a subsidy to purchase Polar Cloud-enabled 3D printers and curricula for educational institutions. In 2017, the program's inaugural year, eight colleges and universities received direct metal laser melting (DMLM) machines, while more than 400 K-12 schools each received two Polar Cloud-enabled 3D printers and STEM curriculum. An estimated 180,000 students now have access to 3D printers due to GE Additive. One goal of the program is to create a pipeline of qualified engineers and technicians to accelerate the adoption of additive manufacturing.

learnbylayers enters distribution partnership with Kodak

In November 2017, Philip Cotton, one of the first U.K. teachers to introduce 3D printing in the classroom, launched learnbylayers, a company selling 3D printing curricula "created by teachers for teachers." After announcing in early February that it was expanding its reseller network, learnbylayers announced later in the month that it had reached a distribution agreement with Kodak. The learnbylayers curriculum will be an additional part of Kodak's 3D Printing Ecosystem, with Kodak offering learnbylayers products along with its Portrait 3D printers.

3D printing lessons offered as part of new Siemens STEM Day program

Together with Discovery Education, The Siemens Foundation, which seeks to advance STEM-related education and workforce development, has modernized and rebranded Siemens Science Day. Now called Siemens STEM Day, the new program offers a constantly available program of STEM lessons and activities for K-12 students in U.S. schools, as well as a teacher support center. One of five new offerings under the revamped program is a 3D Printing Robots lesson, via which students can investigate the application of 3D printing related to space technology. They can also access a lesson on 3D design.

LAB Midwest and Markforged partner to grow 3D printing education footprint

LAB Midwest has partnered with Markforged to expand its presence in the education market in seven U.S. states. Markforged, which is backed by investment capital from Microsoft, Porsche and Siemens, produces desktop 3D printers, industrial grade printers and proprietary software. Its printers are capable of printing in a wide variety of material including carbon fiber, composites and metals. The two companies aim to bring these industrial grade tools, priced to be appealing to educational organizations, to K-12 students, as well as to students in technical and community colleges and universities. Their primary targets are students who share a passion for engineering.



Arts & Entertainment

Maori-inspired ‘carvings’ created with 3D printing

Joe Te Wharau is a New Zealand artist using 3D printing to creating traditional Maori-inspired carvings. His designs employ various materials, including copper. Joe asserts that 3D printing allows him to innovate, by giving him the capability to create designs that would be impossible to realize with traditional tools.

‘3D Photography’ produces commemorative figurines rather than pictures

GoFigure 3D Photography in Owings, Maryland, uses 3D printing to create keepsakes commemorating key life events. Using a lighted photobooth with a series of integrated cameras, owner Lara Thornton takes 2D digital images of people from multiple angles. Customized software then turns these images into a 3D image, which is used to produce a scaled-to-height figurine capturing a person’s likeness. The figurines can be used as milestone commemorations, family portraits, wedding cake toppers or ornaments.

3D printing blends tradition with technology in *Black Panther*

Ruth Carter, head costume designer for the film *Black Panther*, worked with Julia Koerner and Materialise to create 3D-printed costume elements for the character of Queen Ramonda. The film portrays Wakandan civilization, which is both technologically advanced and deeply rooted in traditional African cultures. Using 3D printing to create Queen Ramonda’s crown and mantle allowed the designers to fully combine these competing aesthetics in elements of her costume. Julia’s design combined with Materialise’s access to a wide range of materials resulted in pieces that were flexible enough to be worn comfortably by actress Angela Bassett, while remaining stiff enough to keep their intricate shapes.

Huge 3D-printed sculptures to be installed throughout York

Later this year, artist Matthew Plummer Fernandez will exhibit huge 3D printed sculptures as part of the “York Mediale” festival in York, U.K. The sculptures, created on large format 3D printers, will be installed throughout the city. Plummer Fernandez is producing the sculptures as part of a six-month residency with start-up Fluxaxis, a 3D printing service bureau formed in 2017 and offering services exclusively to creatives. The project aims to “explore the future of manufacturing, digital fabrication and the creative potential of 3D printing.”



Sports

Paralympian turns to 3D printing to create prosthetic for snowboarding

Paralympian Mike Schultz has turned to 3D printing as a way to create a prosthetic needed for his specific snowboarding moments. While most prosthetics on the market are geared toward walking or running (i.e., swings back and forth with each step taken) he needed one that could mimic a squatting motion. He designed the prosthetic – dubbed the Moto Knee – while company Bioadapt fabricated it. Schultz continues to develop prosthetics for other Paralympians to compete in their respective sports.

Team USA leveraged 3D printing to build better luge sled

Team USA's luge team turned to 3D printing leading up to the Winter Olympics, enlisting Stratasy's to help it design a better, more customized sled. The team leveraged its Stratasy's Fused Deposition Modeling (FDM) technology to create molds of their body that then guided the tooling shape for the sled. While the technology is only being used for the tooling process, eventually the company plans to start building 3D printed sleds for the next Olympics.