Finalists

purmundus challenge 2019

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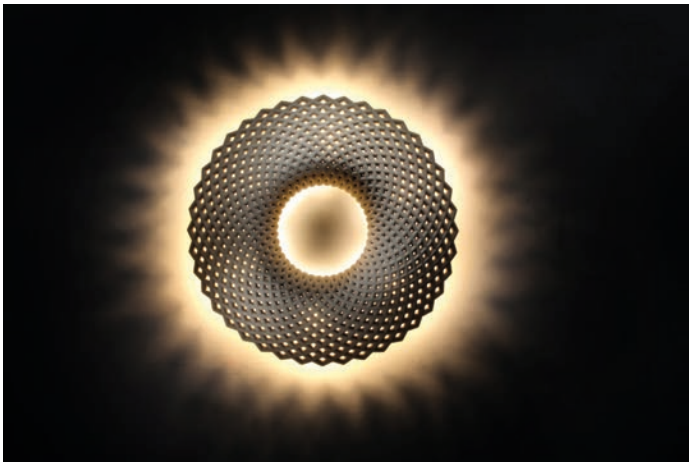
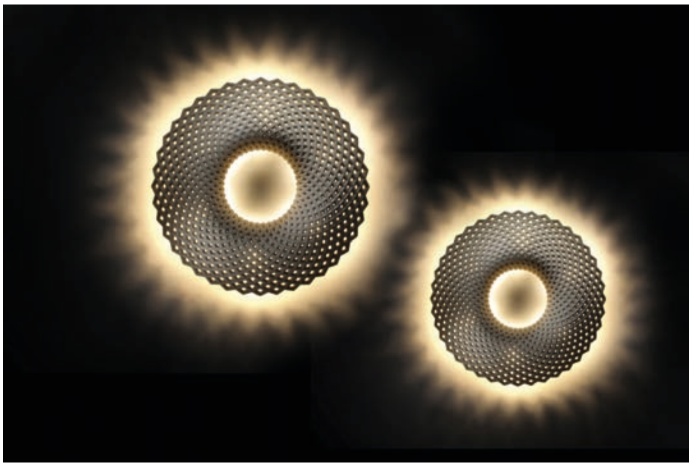
Sandhelden I Ardoma Design I Dror Kaspi

MAYA



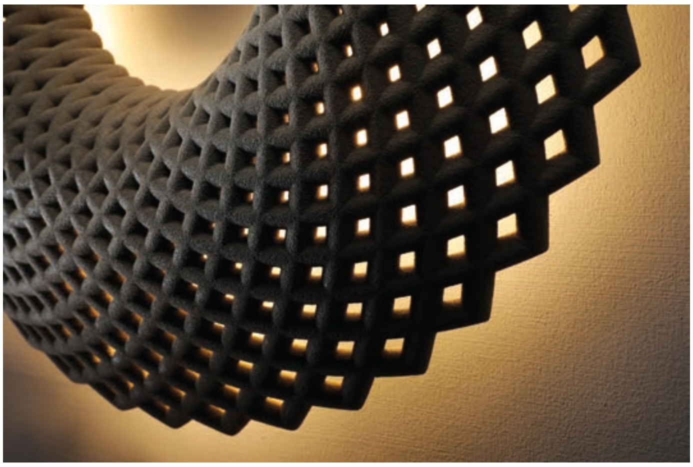


Description

The ancient circular symbols of the Mayan sun god inspired to the Israel-based Design Studio Ardoma Design to create this wall-mounted light fixture. The Spanish word "Malla" (pronounced like Maya) also means mesh and the combination of these two references yielded this delicate shape of bidirectional spirals.

The use of Sandhelden´s technology of 3D printing with quartz sand allowed the geometry of this design to come to life with a beautiful grainy texture. The light penetrates the perforations and spreads out in a pattern of tortuous rays, creating a mesmerizing scene of light.

The exclusive lamp designed by Ardoma and produced by Sandhelden will be launched to the market at the end of November from both parties and more new products will appear in the upcoming time.



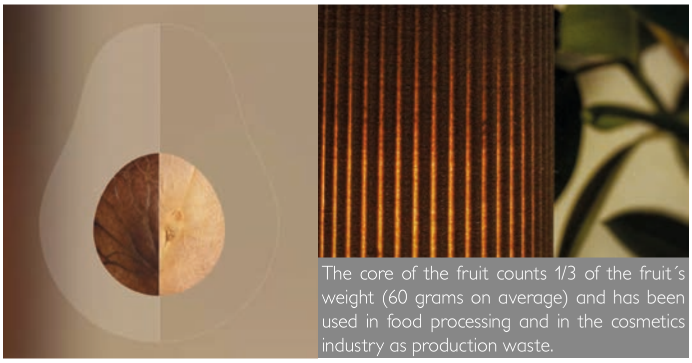
ARDOMA Creations

SANDHELDEN

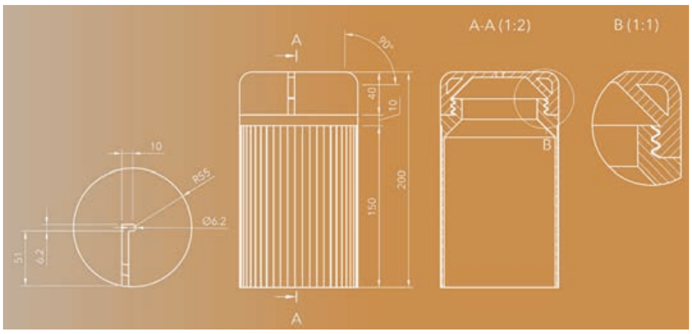
Kathrin Breitenbach Studio Scenography, Interior Architecture & Design I Kathrin Breitenbach I Vincent Fischer I Ilhan Kahraman

Persea Lighting

3D printed interior design made out of Avocadoseedwaste



The core of the fruit counts 1/3 of the fruit´s weight (60 grams on average) and has been used in food processing and in the cosmetics industry as production waste.



Lighting

DESIGN The translucency and structure of the material enable sophisticated formations that can be used artistically to play with light. The finely layered 3D structure of the luminaire body is additionally emphasized by the light. The fine furrows created by the three-dimensional pressure can also be used as a design method.

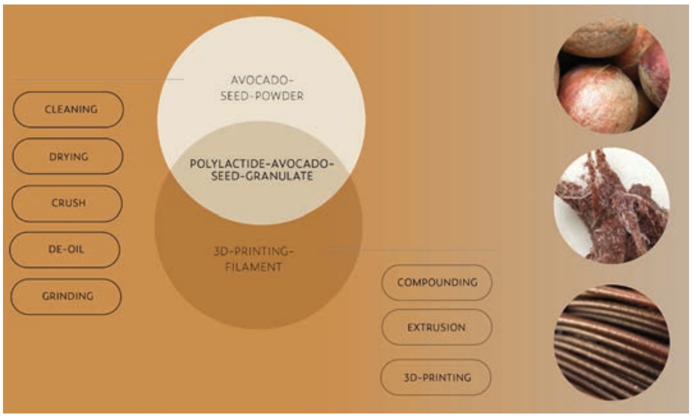
Depending on the additive addition of the core in the filament development, the light transmittance can be influenced. By adding natural color pigments, the optics can also be changed.

Introduction

Persea is a modern, 3D printed Lamp, consists an organic Avocadoseed-Thermoplast. The Construction of the lamp consists two parts. The cover and the light basket. A thread connects both parts. In addition, the luminaire lid has a recess hat makes it possible to place the luminaire on existing lamp holders without the aid of auxiliary equipment. The modular design offers diversity in design. So the body can be replaced, instead of being replaced by a new light. The total weight of the lamp is 260 grams, the percentage of the avocado seed is 35%.

Avocadoseed

The avocado causes enormous carbon dioxide consumption, which accelerates climate change. In growing countries, the increase in production leads to illegal deforestation and the illegal purchase of water. The import volume of the fruit has doubled in recent years twice. 58,500 tonnes of avocado fruit were imported to Germany in 2016. The additive manufacturing process offers an individuality in the design of the luminaire. Circulations can be designed variably without overproduction. (The seeds are provided by nearby restaurants.) The transformation to a sustainable design, a return to a reduced and resource-saving material development should not be inferior to the requirements of aesthetics, quality and functionality of regular design objects. Consumers already have an awareness of sustainable consumption, but the level of consumption is not close enough to restrict themselves and forego the luxury of consuming the fruit. The development of an appealing product in the furnishing sector should remind people in everyday culture that the hitherto disposed of the avocadoseedwaste can also find further use.



Persea

We design modern, 3D printed designed products with the most adjustable features of biobased platic products from avocadoseeds in combination with an organic based thermoplast, to support the start of a new, sustainable Design-Era.

At the beginning, there will be a product line, which will be added quarterly. 3D printing makes it possible to manufacture individual products that save interest, and these are to be offered limited in time intervals, so that there will be a range of changing design products from the PERSEA line.

CRÈME / Jun Aizaki Architecture & Design I Jun Aizaki

The Gourd Project

Design Statement

We are in an urgent need to shift our current cradle-to-grave paradigm. Take-away cups and packaging are a standard of everyday life but they produce an incredible amount of waste that ends up in landfills and contaminates our precious waterways and landscapes. What if aside from being a materal resource, nature could also provide a solution for this worldwide issue? For the last few years, CRÈME / Jun Aizaki Architecture & Design has been exploring a way to bypass this waste cycle through a biodegradable molded gourd. We call it the "The Gourd Project".

Our Solution

Along the exploration that this thought intitiated, CRÈME identified gourds as a fast growing plant that bears robust fruits each season, developing a strong outer skin, and fibery inner flesh. Once dried, gourds have traditionally been used by ancestors as receptacles like cups. CRÈME explored this centuries-old craft, using molds to grow gourds into functional shapes, such as cups and flasks to create sustainable, renewable, and compostable products without waste.

The Gourds History

Gourds in the daily lives of native people, that they were introduced into human cultures throughout the world. Probably their most important use was for containers, including pots, pans and bowls, and these gourds are still used to this day in many parts of the world. For water vessels, they are still preferred over earthenware jars because they are lighter and they cool the water by evaporation.

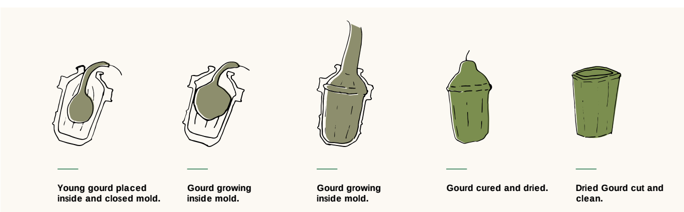
The Gourds Inspiration

"In Japan watermelons are grown in little boxes so that they become square. It looks quirky and weird, but it makes them easy to stack and transport. The idea is giving nature a little bit of a nudge to form it into shapes that would be more functional." - Jun Aizaki

Gourds are fast-growing plants that bear robust fruit each season. Once dried, the gourds' strong outer skin and fibrous inner flesh becomes watertight – so these crops have been used for centuries across the globe as decorative or functional vessels. CRÈME is exploring this centuries-old craft through a modern lens to create a product that we believe can be mass produced while maintaining its sustainability. Through the use of 3D printed molds, we can grow gourds into customizable functional shapes, such as cups and flasks that can be composted instead of filling up landfills like the plastic alternative.

The Gourds Design Process

Aside from the sustainable benefits of The Gourds, the 3D printed mold allows us to create a deliberate aesthetic that can be both beautiful and functional. Through many studies and prototypes, we have developed a set of pieces that mimic the silhouette of a classic faceted glass cup and a carafe with a lip detail.



The Gourds Growing Process

Even though the practice of molding gourds has been around for centuries, there are complications to mass producing a consistent product with an organic material. We started our experiment growing a few gourds outside in our backyard and eventually found a farm to take on a larger batch. However, there are a variety of factors that cannot be controlled in an outdoor environment, such as humidity, pests, weather, and flooding. We would like to explore growing gourds in a controlled setting to limit these external factors and see if we can produce a more consistent product.

The Gourds Indoor Labs

The Gourd Project Indoor Lab is the next step in this journey to finding a sustainable alternative for the notorious plastic cup. Like all new projects, we are starting small and hope to scale up to increase quantity and lower the price per gourd, so that The Gourds can be a viable challenger to the plastic waste industry. We plan to initially invest money towards R+D, so we can grow the gourds in both indoor farming facilities and outdoor farms, allowing us to scale up the quantity and lower the price per gourd. The goal is to keep the high quality and quantity, so that The Gourd can be a viable challenger to the plastic waste industry.

The Gourds Future

We hope to introduce The Gourd Project initially to a niche market, such as the coffee or tea industry. We would love to work with eco-conscious or green companies. For example, Clif Bar, an American company that produces organic foods and drinks, reached out to us to inquire about replacing all the cups in their offices. Another possibility would be to partner with a specific brand like Think Coffee, which has implemented projects related to feminine hygiene, adult literacy, medical care, reforestation, and housing restoration. After that, we would love to collaborate with large companies like Starbucks which has high average number of customer per day.

The concept of The Gourd Project is not only for one product but an idea to limit waste associated with singleuse plastic. The process of creating The Gourds can be applied to various products all across the service industry. Imaging this technique can replace the item which need a thin plastic surface, we can apply the process to packaging, accessories, such as a lamp and technology, such as speakers, using the natural acoustic of the gourds to improve the sound of a phone.

The Gourds Design Features

- Our goal is to replace the single-use plastic cup with multi-use gourd cups.
- Single-use plastic cups are not biodegradable and cause a mass amount of waste, which we aim to reduce with this fully biodegradable cup.
- We need to scale up to a mass production model, either using indoor farming techniques, grow lights, or a controlled environment that can help speed up the process and expand our reach.
- Most of the "biodegradable" cups that are on the market, are lined with a chemical to ensure that they do not leak, but the chemical is not compostable. Our product is free from chemicals and fully compostable.
- We aim to increase interest and awareness in ideas such as ours, in hopes that it will lead to further experimentation and research by potential partners.

Taktilesdesign GmbH I Sylvia Goldbach

Ingwer-/ Wasabi & Muskatreiben

Concept

Ginger/wasabi & nutmeg grater produced using additive methods

Idea & claim

1. In Japan, wasabi was traditionally grated using shark skin. As texture designers, this inspired us to develop optimised grating surfaces. The aim is to expand the "wasabi grater" into a collection of graters for different foods. This is to be brought to market maturity in a range of variants with small unit volumes.

2. Using texture as functional and aesthetic added value in order to cost-effectively improve surfaces using additive production.

Need

1. Our research revealed a lack of wasabi graters on the market. Most of them are difficult to clean, or not made from durable materials (perforated metal, wood, ceramic). Grating ginger to make tea is hard work, with chips and fibres that block up the grater. Our ginger grater is designed to grate the ginger more effectively and finely.

2. Surfaces produced using additive methods are not high-quality. Subsequent milling or adding texture using lasers is expensive and/or time-consuming. Textures that are built up directly using additive methods offer an easy way to personalise products, and add quality to a surface.

Product & design

Grating roots, nuts and fruits has been an essential food preparation process since time immemorial, and one that is shaped by the direct enjoyment immediately afterwards.

Our goal was to create a lasting and customisable product for connoisseurs, between archetype and high-tech. The design takes the form of a half-shell, with a grating surface at the front or back.

Three different surface textures are based on wasabi leaves, the surface of a nutmeg and the cross-section of a peeled ginger root.

The grating surfaces differ, with larger teeth for wasabi, sharper teeth for nutmeg, and finer, more rounded teeth for ginger.

There are two design variants for the grip. The "Globe" head is enclosed and perforated, while the "Tacman" head is open and can be cleaned on the inside. The designs and the grater's shape are protected by various patents registered with the dpma.

The two-sided (ginger and nutmeg) or one-sided graters are available in two different sizes. The grater teeth are designed to grate ginger, wasabi, garlic, carrot or apple, for example, into a fine purée and to directly release the flavours. Except for the peel there is almost no waste. Ginger is made much less fibrous, as much of the fibres are grated as well. The shape and finish of the graters make them very easy to clean. As part of our texture process we create an open file that allows textures and grating surfaces to be changed with the click of a mouse button. We set the file size to a manageable volume by using and optimising for 40µm slices, which also reduces the manufacturing time.

The process

The logical consequence of using additive production to make stainless steel pieces comes mainly from a price comparison with conventional methods. The modelling of the basic structure is optimised for additive production, with the shape being built vertically and requiring almost no support structures, which makes it possible to apply the texture to the full surface and give it a high-quality appearance!

- Modelling including texture/grating teeth - file size of 150MB easily manageable
- Production with 40µm layer strength, 12h* / 18h** in 1.4404 stainless steel
- Removal of support in 2 downskin areas - blasted corundum/ceramic
- Plasma polishing process - acid-free, sterile, ideal set-up

Design versions can be mixed; production time: 2 days

The surface is finished using electrolytic plasma polishing. This involves dipping the grate in water containing conducting salts under an electric current. This induces a plasma, which polishes the grater very efficiently and in a way that is environmentally friendly by means of electrochemical reactions. The result of this chemically harmless process is a glossy, sterile surface with no loose particles.

Comparison with precision casting: The version with the enclosed globe cannot be cast. Only the "Tacman" head can be compared. Even with a silicon mould for a higher unit volume of 100, precision casting is no alternative from a price perspective. A separate mould would also be required for each design version and size, and the costs would have to be invested in advance.

- Modelling including texture/grating teeth - file size of 150MB easily manageable
- SLA print of a template model
- Mould made from silicon for 100 units
- Wax mould/hanging and casting
- Cleaning and blasting
- Polishing process, ideal set-up

Production time of 18 days, design versions CANNOT be mixed, larger unit volume required to maintain price

Marketing

Combined with a mahogany upcycling stand ("I used to be a door") and packaging made from printed cork leather, we arrive at a very appealing product.

The price (including a margin for distribution partners) is within the range for exclusive design products but not excessive. The smaller, 115mm graters are available for €109-119 including postage and packaging. The larger wasabi graters are only available as prototypes at the moment.

* Ginger/nutmeg and combined graters, 115mm tall
** Wasabi graters, 155mm tall

SUGAR O´CLOCK

SUGAR O´CLOCK is a functional 3D printing clock made of Sugar

SUGAR O´CLOCK takes into account my own relation with sugar and the fact that as a diabetic person sugar is a poison that harms my body. From this fact, the foundational statement of the series takes shape from the desire to reconvert sugar into a building and constructive biomaterial for future. A hybrid between a clock a lamp and cow udders. The condition dictates timings and activities of a diabetic life.

The first treatment for diabetes consisted of Insulin extracted from pigs and cows.

I name the pieces material HYPERGLYCEMIAPOLYMER OR H.G.Polymer. My research path on the technique explores the physicality of sugar crystals for creating new types of materiality. Taking this very familiar ingredient together with other ingredients used in the bakery industry and applying it to a new process of experimentation, altering molecular structures.

As a result, a technique has been developed that uses a laser to sinter a sweet mixture creating a sugar-based bioplastic a procedure that allows producing objects adding so a particular sense of aesthetic value to a material that we otherwise will take for granted.

EAP® Abutment

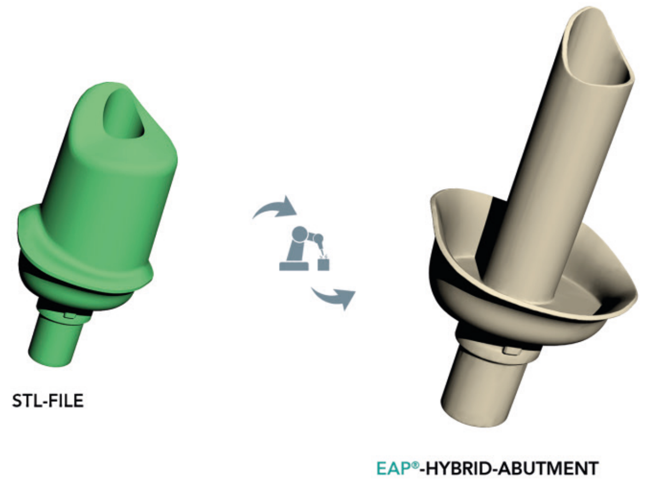
Inconvenient gingiva progression for esthetics — Titanium rim modified — Aesthetic appearance

The new Abutment

Aesthetic. Biocompatible. Customisable. For any implant system.
The field of dentistry has changed fundamentally in the last 10 to 15 years. The wide-ranging demands posed by the combination of patient comfort, long-term stability, handling, biocompatibility and high aesthetic standards pose a challenge. We see failures of aesthetics or biology in the field of implantology almost daily. EAP® grew organically from the demands of daily requirements in the field of dentistry.

EAP® is a complete innovation on the dentistry market, and has been protected around the world with the granting (and already the successful defence) of a patent. The production process was developed by Prof. Kern between 2017 and 2019. An application for an international patent for the process was submitted in 2019. The product is a prosthetic attachment that is required for all individual tooth and bridge treatments, regardless of the system used. With the medical product EAP®, the dentist or dental technician no longer needs to choose between a biocompatible or an aesthetic product because it combines both benefits in the simplest possible way.

EAP® is a more biocompatible, highly aesthetic, scientifically documented, problem-solving hybrid abutment for tooth implants that works with any implant system, has improved adhesive properties and is easy to use, and is the world's only abutment that can be subsequently modified. Our B2B business model for EAP® is based on the patented product innovation that targets user's specific needs (the abutment) but also the successful development, testing and implementation of a fully digitised high-tech production process based on laser sintering technology and a high-precision milling process. This process is offered online via a digital interface and with the greatest possible degree of data security for the target group of dentists and dental technicians. The name EAP® is already registered as a trademark in the main markets. The first deliveries of EAP® went out in September 2019.



Production

The core of the production process is a unique, highly economical hybrid production process that constitutes a quantum leap for speed of production and precision. This will enable EAP® to cope with a very large volume of orders without needing to invest massively in a lot of machinery. Software used: Geomagic Warp, Materialise, Hyperdent Devices: 3D printing: Concept Laser MLab 200 | Material: exclusively titanium, CNC milling machine: Georg Fischer HSM 200, CNC lathe: DMG Mori Sprint

The machines are validated for special production in accordance with the German Medical Products Act 13485:2016.

Production process logistics
A dentist or dental technician sends us an STL file (global standard), which we convert automatically. This means that the technician or dentist is free to choose what method of processing he or she would like to follow. Delivery is made in two to five work days. The first phase of production in pilot operation has already been completed, with the DACH countries and then the EU to follow. The second important step is sale in Australia, Canada and the US.

In order to gain a better understanding of the product, we recommend viewing the product video on our home page www.ea-platform.at/medien.

Philipp Hainke I Paula Cano Gutierrez

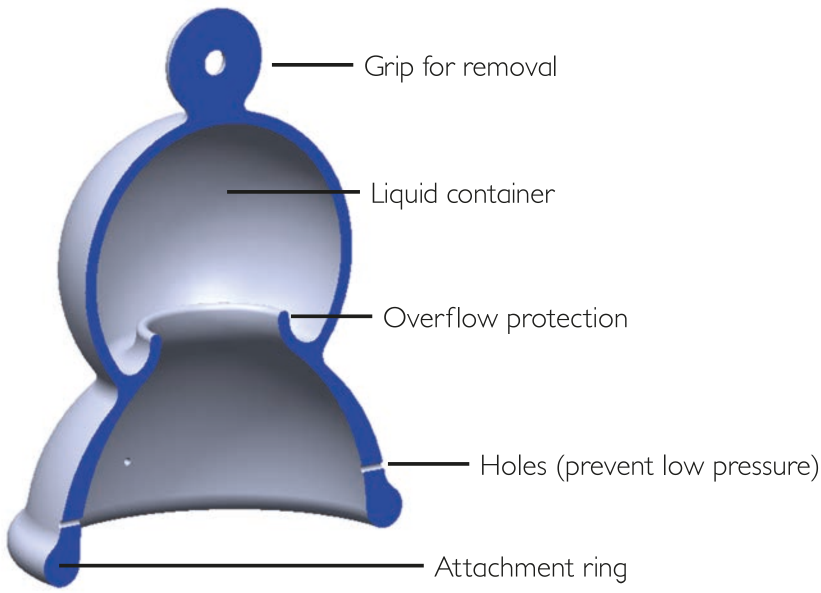
Cherry-Cup

Description

Cherry Cup is a menstrual cup that replaces the conventional tampon. Unlike existing products, the design offers unique properties.

3D printing allows the shape to be adapted to the morphology of any woman, which ensures the utmost comfort. The design consists of two core elements: a funnel-shaped opening ending in a small outlet, and a ball-shaped container capable of holding a high volume of liquid. The technical intelligence of the object lies in a membrane between the funnel and the container, ensuring that the blood is kept securely inside the container. This unique system is made possible by a new 3D printing process developed by Spectroplast. This new process allows us to create highly durable, flexible 3D-printed items that can be worn on and inside the body without concern.

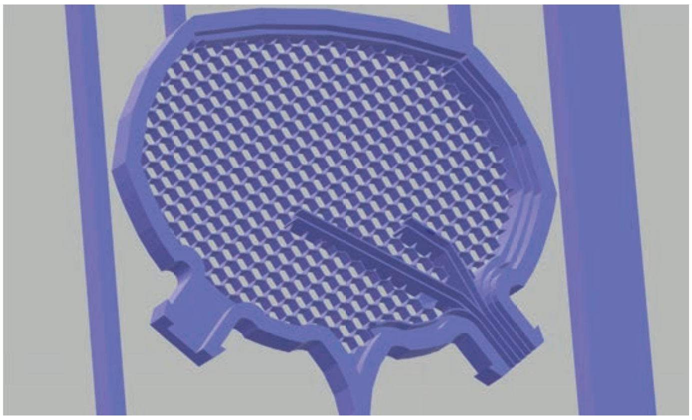
In addition to its functional aspects, the Cherry Cup was designed to be a friendly and emotional object that makes it easier to form a connection.



Mit freundlicher Unterstützung von
SpectroPlast

Technische Universität Hamburg, Institut für Mikrosystemtechnik I Prof. Dr. Hoc Khiem Trieu I
Jana von Poblotzki

QLIMP-3D



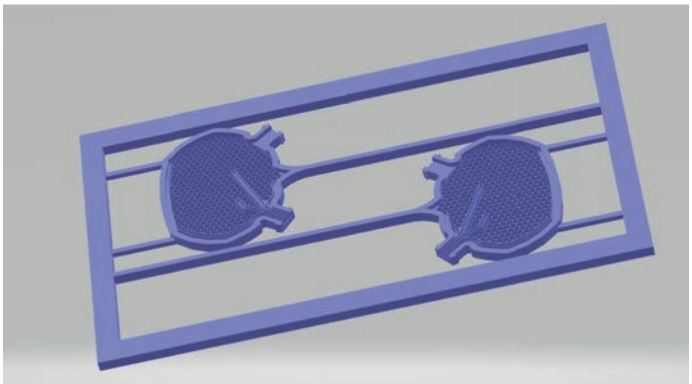


Fig. 2: Two mirror-inverted halves of the QLIMP device.

Product description and concept

QLIMP-3D is an implant for the regeneration of injured spinal cord. The function of the regeneration implant (QLIMP) has been proven in long-term studies in a rodent model. These worldwide unique results have been published in 2018 in Nature Communication Biology. Towards a potential human use the method is currently transferred to a minipig model. The use of 3D printing will enable the fabrication of patient specific implants taken into account the individually different injuries of the spinal cord.

Spinal cord injury (SCI) is a life-changing event potentially leading to permanent paralysis. Until today there is no curative therapy. A biocompatible implant (QLIMP) promoting regeneration after SCI has been developed at Hamburg University of Technology and successfully tested in a rodent model[1]. The system is currently transferred to minipigs and being under test. For future potential therapeutic use in humans, individualized and biodegradable implants are desirable. A 3D printing approach would be ideal for the fabrication of personalized implants (QLIMP-3D) taking into account the individually different injuries of patients.

The working principle of the implant is depicted in fig. 1 presenting the course from a complete cut (transection) of the spinal cord to the implantation of the QLIMP device, followed by optional drug delivery and the regeneration process. Finally, the implant gets resorbed after regeneration of the spinal cord has been completed.

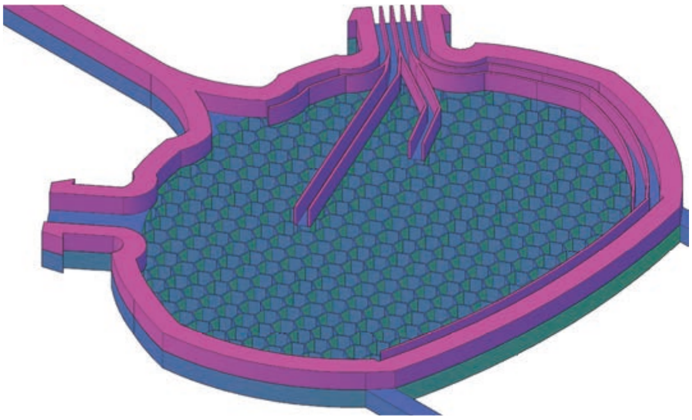
The function of the implant relies on the design which is as simple and unique at the same time. The honeycomb structures enable a mechanical readaptation of the spinal cord with maximum filling factor and stability. Integrated microchannels enable the application of a short-term vacuum (approximately 300 mbar negative pressure for about 10 minutes) during implantation to minimize the gap between the transected stumps. This mechanical readaptation of the spinal cord supports the regeneration process winning the race against the inhibition process which is taking place in parallel after spinal cord injury. The integrated microchannels also allow the application of drug delivery to further support the regeneration. The fabrication of the QLIMP device is achieved by putting together two halves of the implant as shown in fig. 2, creating the embedded mirochannels.

The design of the honeycomb and integrated microfluidic structures as well as the proper surface engineering ensuring an optimized ratio of smoothness and adhesion are key elements of the success. These features require micro meter scale patterning of the implant.

The precision of the implant has been achieved using traditional silicon based micro-technology. The time consuming sequential process steps of photolithography and etching are beneficial for batch high volume production. However, for personalized single device a new approach using 3D printing is required.

Currently, we have achieved this by the use of subtractive 3D printing (a selective laser induced etching method called SLE) as a rapid tooling technique for the fabrication of individualized premasters made of quartz glass required for the following micromolding of the biocompatible and biodegradable QLIMP. In future, direct printing of the QLIMP-3D device using additive method will be investigated.

[1] V. Estrada et al., "Low-pressure micro-mechanical re-adaptation device sustainably and effectively improves locomotor recovery from complete spinal cord injury," Nature Communication Biology, vol. 1, no. 1, p. 205, 2018.



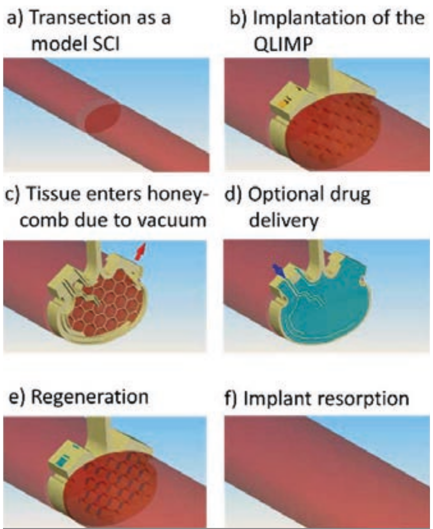
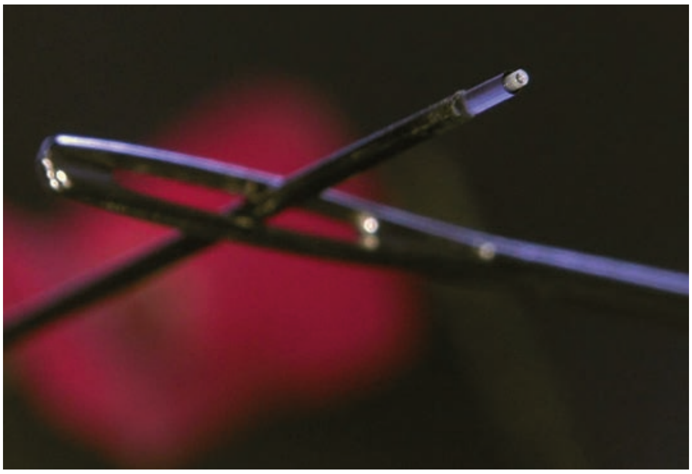


Fig. 1: Working principle of the QLIMP

Institut für Technische Optik, Universität Stuttgart I Andrea Toulouse

3D-printed miniaturized endoscope



Description

When it comes to our health, the size of surgical instruments is a very relevant factor. Of course, we want to be treated as noninvasively as possible. Keyhole surgery is already a vast field in modern medicine where the medical procedure is executed through a minimal incision and miniaturized equipment will further support this trend. Here, modern 3D printing can push the limits of endoscopic systems to the next level. It is now possible to 3D print imaging lens systems directly onto optical fibers. Thus, we can not only reach endoscope diameters of only hundreds of micrometers, comparable to a human hair, we can also exploit this freedom in optical lens design and are no longer limited to use conventional surface shapes.

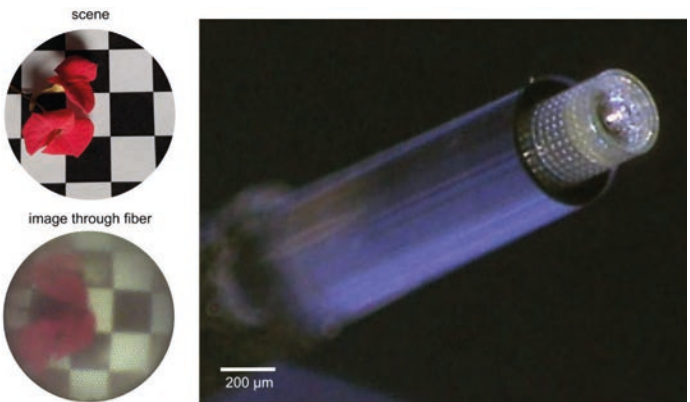


Fig. 1. The 3D printed miniaturized endoscope is so small that it fits through the eye of a needle. A color image of a macroscopic scene can be transmitted through the diameter of only 500 µm. The freedom of design in 3D printing enables an elaborate functional design that is printed directly onto the fiber tip.

The product suggested here is a 3D printed miniaturized endoscope which has a maximum diameter of just 500 µm. The concept is illustrated in Figure 2. The tip of an optical multicore fiber is equipped with a 3D printed imaging objective. Each image point is then transported by one core of the flexible fiber bundle. At the rear end of the fiber, which would be outside the human body in a surgical application, the image can be observed and recorded with a (video-)microscope. This miniature endoscope is so tiny, that it fits through an eye of a stiching needle or even a cannula and can transfer a color image from one end of the fiber to the other (Figure 1).

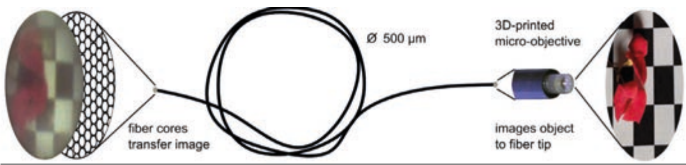


Fig. 2. Working principle of the miniaturized endoscope. A macroscopic scene is imaged by the 3D printed micro-objective to the tip of an optical multicore fiber. The fiber cores transfer the image to the fiber's rear end where it can be observed through a magnifying video system.

The micro-objective is fabricated with a two photon polymerization process using the 3D printer "Photonic Professional GT" (Nanoscribe GmbH). This 3D printing technique stands out due to its miniature voxel size of approximately 150-450 nm. Therefore, small volumes can be printed with optical quality and very high accuracy into a droplet of liquid photoresist which is subsequently developed and cleaned. A detailed rendering of the CAD model and the 3D printed product are shown in Figure 3. In this product, the process is used to print directly onto the tip of an optical multicore fiber. The lens mount and the aperture of the system are designed such that they comprise an elaborate system of microchannels and holes so that the liquid photoresist can be rinsed after the 3D print. In a subsequent fabrication step, this microchannel system can also serve as a reservoir for non-transparent ink to increase the contrast of the image even further.

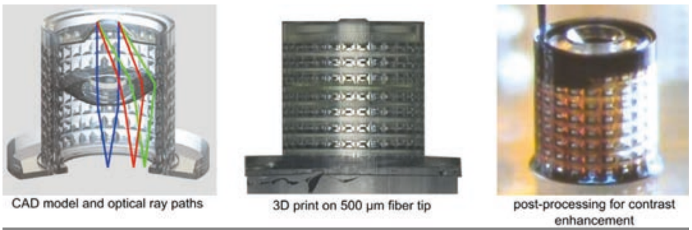
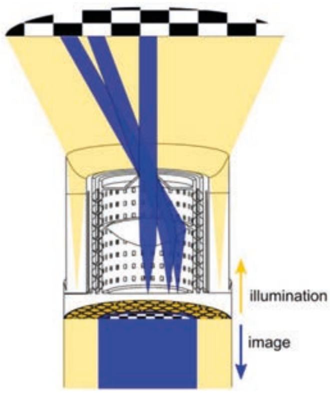


Fig. 3. Left and middle: Rendering including optical ray paths and microscope image of the 3D-printed objective - the heart piece of the miniaturized endoscope. Right: post-processing of a 3D-printed objective with non-transparent ink to further enhance the image contrast.

The product presented here is easily extendable. Further elements can be added to the 3D model and printed at almost no cost. For instance, Figure 4 illustrates the integration of an illumination system. Since the fiber cores can carry light into both directions, a part of the bundle could be used for illumination purposes. In this example, the outer cores transmit light in forward direction and a guiding system is added to the 3D model that directs the light towards the object by the use of total internal reflection and a concave end facet. At the same time, the image is carried by the inner core bundle in the opposite direction towards the observer. The 3D printed endoscope has the potential to surpass conventionally fabricated devices in multiple areas. The freedom provided by the production process can be fully exploited in optical design. Freeform surfaces and undercuts are possible and enable the optical designer to create multi-lens imaging systems that magnify, demagnify, or observe at an angle, which is an impossible task using conventional so-called GRIN lenses. The possible product line-up is thus expected to fill marked niches. Of course, these systems are highly relevant to our society since they push medical technical possibilities to the next level.

This product was developed in a joint project of the Institute of Applied Optics (Prof. Herkommer) and the 4th Physics Institute (Prof. Giessen) of the University of Stuttgart.



DEEPTIME s.r.o I Ondrej Chotovinsky

Ionic Sound System

Handcrafted Speakers inspired by natural forms

Primeval Design Progressive Sound
The first audio system 3D printed from sand.

The sound of where we're from
Ionic stands for fundamental. For the foundations of thought, geometry and music. Ancient Ionian philosophers advanced geometry and mathematics, inspired by the shapes they saw in nature. From the Sphinx of Naxos to the United States Capitol, civilization rests on the spiral volutes of Ionic columns. The resemblance to the ammonite shells found in the Ionian Sea seems less than accidental. It is no wonder then, that the major musical scale defining the western understanding of music is also called the Ionic mode.

Made to look and sound great

The lines in the sand
The Ionic Sound System is designed to be both a superb sounding audio solution and a sculptural object. The textured sand gives the enclosures a very distinct look and feel. The weight and density of the material, reinforced by custom-made hardener, prevents unwanted frequencies. Every speaker is made from a single piece with no visible split lines or bolts holding the enclosures together. This is achieved through additive manufacturing techniques. As a welcome side effect, this creates visible surface layers resembling the exposed lines of sedimentary rocks. Think Grand Canyon, Hunstanton Cliffs or the tectonic plates. The material and the method are the perfect match for both sound and aesthetics

SPIRULA SPEAKERS - Passive satellite speakers 3D printed from sand.

SPIRULA SPEAKERS
Limited edition of 1618 sets.

Intelligent Design
The spiral-shaped cochleae present in the human ear greatly extends the range of frequencies and octaves we can hear.

The perfect shape for sound

Evolved sound
The evolution of the Spirula speakers took years of research. Optimized for high efficiency, the speakers deliver pristine sound without carrying any unnecessary weight. These speakers are as sleek as it gets. The tapered interior surface is entirely rounded with no flat surfaces. This ensures that any vibration produced by the driver does not get reflected toward the listener, guaranteeing audio clarity. Spirula speakers are driven by three-inch full range speakers with highly accurate sounding bamboo fiber cones. The fiber is tough but flexible, able to withstand high volumes and absorb its own vibrations. The speaker cone surround is made of santoprene, an extremely light, flexible and extraordinarily durable type of polymer. Its minimal weight improves the frequency response of the speaker and high elasticity helps to reproduce lower resonant frequencies.

THUNDERSTONE SUBWOOFER - Active subwoofer with deep bass power

Turning sand into thunder

The BASS TRINITY
The Thunderstone delivers incredible power in a compact form. Through a holistic design process, we've arrived at the most efficient driver, shape and overall proportions for a pristine and rich bass sound. The shape is inspired by the fossils of black sea urchins, with the height and diameter in the golden ratio. The trilateral symmetry is a crucial part of the design. The shape allows for three bass ports. The advantage of multiple ports is partly in the reduced size of the individual ports, each 1.618 inches in diameter. More importantly, the form can contain much longer resonant tubes than single port or rectangular shell can. A trident of round tipped spikes carries the weight of Thunderstone. Their purpose is to minimize the area the speaker touches. The less contact the subwoofer has with the surface below, the fewer vibrations pass between the two.

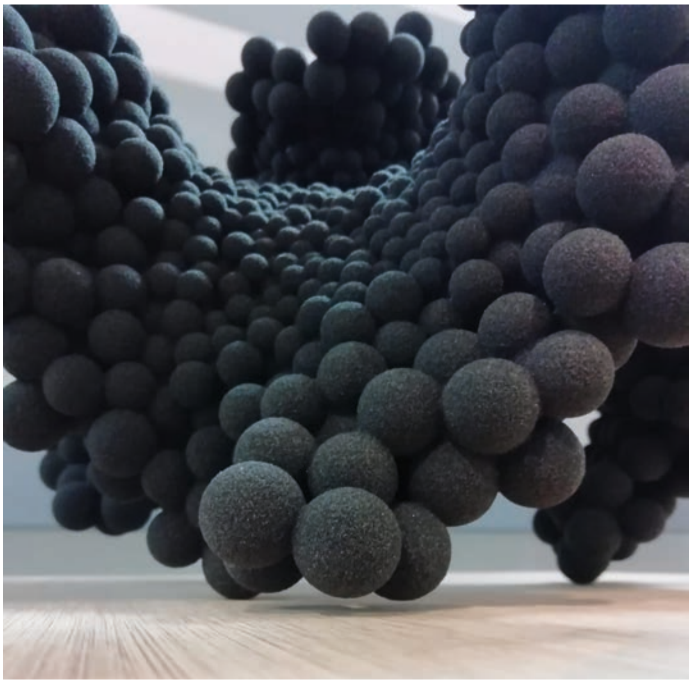
The light in the deep

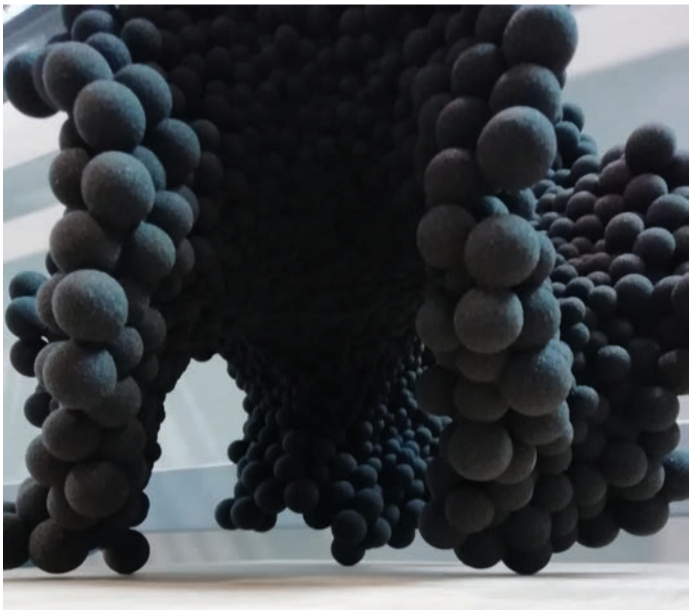
Mimicking deep-sea bioluminescent creatures, each bass port also contains an LED light source. A subtle amber light indicates when the subwoofer is plugged in and gently brightens as the volume increases.

Video: www.youtube.com/watch?v=c0EWk_ok2gQ

Sandhelden I Minimaforms I Theodore Spyropoulos I Stephan Spyropoulos

Dark Matter





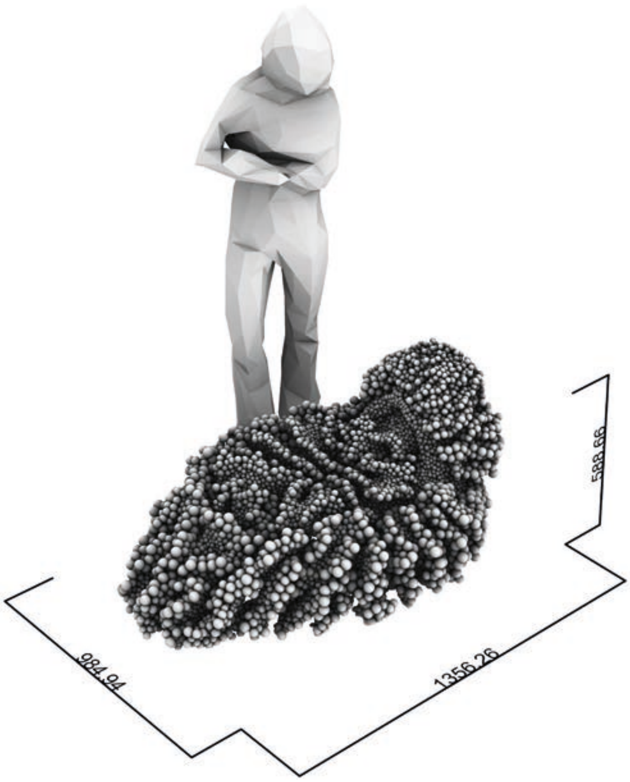
Description

Dark Matter takes its name from the speculative formational simulations of dark matter structures that are constructed to describe swarms of galaxies to dust and plasma.

It is a cosmological construct that articulates new conceptions of our understanding of the universe. Working through this inspirational thought construct, Minimaforms conceptualized a strategy to explore Sandhelden´s sand printing process and the complex structuring of time based form through particle based cellular growth structures.

Cells simulated to interconnect through forces and internal accumulative rules create an iterative process to construct a prototype of the most basic of human designed objects, a chair.

Minimaforms´ chair prototype is a moment in time that utilizes particles scaling and clustering to create a prototype that can iterate for structuring density and resolution based performance. Minimaforms has customized a workflow that works through various scripted 4D frameworks to deal with high-resolution particle simulations and meshing files for print.



The world's first 3D-printed, smash proof guitar - tested by rock-legend Yngwie Malmsteen

Description

How Sandvik Additive Manufacturing 3D printed the world's first smash-proof guitar

Rock stars have been smashing guitars for decades, few with more enthusiasm than guitar virtuoso Yngwie Malmsteen, named one of the Top Ten electric guitarists in the world by TIME magazine. Sandvik decided to test their cutting-edge techniques by building the world's first 3D printed, all-metal, unbreakable guitar and letting Malmsteen unleash his smashing skills on it. Sandvik gathered experts from across the company to demonstrate how its engineers could use sustainable, cutting-edge techniques to make something that is both highly precise and amazingly durable.

"Nobody had printed a guitar body of titanium before."

"Materials technology, precision machining, additive manufacturing and data-driven production – these are the kinds of processes it takes to create something as complicated and beautiful as a guitar for a master musician," said Kristian Egeberg, president of Sandvik Additive Manufacturing. "But we also wanted to show that we could make it unbreakable, no matter how hard Yngwie tried to smash it. This project seemed like a perfect match to demonstrate our skills and capabilities – and his."

Strength layer by layer

Drawing on the company's deep, industry-leading knowledge of materials and manufacturing processes, Sandvik decided to use additive manufacturing, or 3D printing, for the guitar's body. 3D printing allows tremendous design freedom. Complex internal lattice structures, impossible to mill, can be built into components to make them lighter, stronger and more flexible than ever before. The guitar body would need that once Malmsteen got his hands on it. But Sandvik's design partner on the project, UK-based guitar designer Andy Holt of Drewman Guitars, had no idea if this was even feasible. "Nobody had printed a guitar body of titanium before," Holt said. Sandvik Additive Manufacturing engineers were confident they could do it. Amelie Norrby, an additive manufacturing engineer who participated in the guitar project, said that the printing process began with software "slicing" Holt's design files into digital layers. "Additive manufacturing is a truly digital production technology. It creates a threedimensional object directly from a digital design," Norrby said. "If you can design it, you can print it."

Powder Bed Fusion Laser

Those digital design layers guided the printer's lasers as they melted microscopically thin layers of titanium powder on top of each other until the body was built up. Called Powder Bed Fusion Laser, this additive technology is ideal for printing metal components with extremely complex geometries. "As its name implies, additive manufacturing adds material to create an object. It builds up three-dimensional objects by adding layer-upon-layer of fine metal powder, and melting them together with, in this case, laser technology," Norrby said. Each layer was 50 microns thick (thinner than a human hair). Printing the body took 56 hours. The guitar's volume knobs and tailpiece, which anchors the strings, were also printed using additive manufacturing.

Watch the film 'The Smash-Proof Guitar': www.additive.sandvik/guitar
www.youtube.com/watch?v=4TKXvyYxoVw

Adding sustainability

Norrby chose to work in additive manufacturing because she thinks it's one of the most disruptive technologies to have emerged in recent years. She also thinks its inherent sustainability makes it an important and game-changing technology for the future. "Additive manufacturing is more sustainable because you only use exactly the material you need for the component, reducing waste to almost zero," Norrby said. "Any powder remaining in the printer can be recycled for the next project."

Besides minimizing waste, additive manufacturing removes steps in the supply chain. "You go directly from a digital design to a three-dimensional product. And, if you locate production close to where it's needed, you can also cut down on the storage, packaging and transportation of parts," Norrby said. Sandvik is a world-leading manufacturer of metal powder for additive manufacturing and has all relevant print technologies for metals in-house, being able to select the most optimal print process and material for each application.

An advanced group effort

The opportunity to solve highly complex production challenges with advanced technologies like additive manufacturing is why Norrby, a top engineering student during her university years, came to work at Sandvik. "I'm surrounded by world-class innovative thinkers, and we're part of the ongoing industrial revolution that is additive manufacturing," she said. "This guitar project let us collaborate and test new innovative ideas. In a few years from now, these ideas could be used for something completely different, something that might make the world a better place."

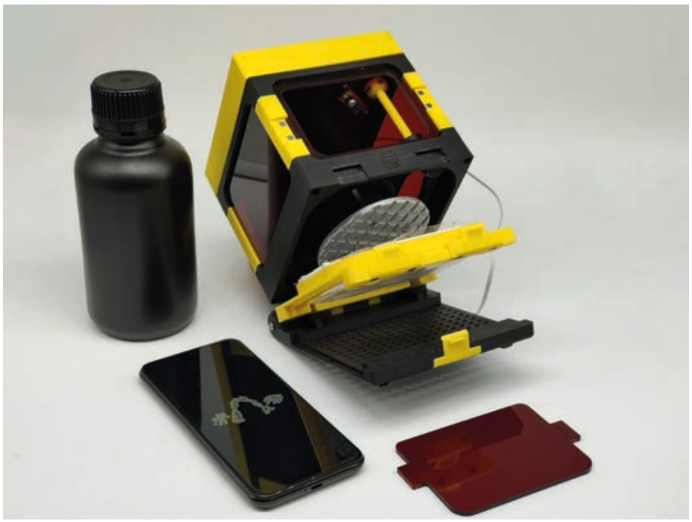
Norrby's additive manufacturing team worked closely with engineers at Sandvik Coromant, who milled the fine, luminous finish on the guitar body. And colleagues in Sandvik Materials Technology contributed with knowledge about how materials would be joined together. "We've been making our own metal powders for more than 40 years, and we've been selling them in the additive manufacturing market since 2002. Sandvik offers the widest powder alloy program for additive manufacturing, and we can even customize materials for specific customer needs," said Norrby. "We're also a world leader in post-processing and machining printed metal components. Printing is only one of several steps in the production process of high-quality additive components. We have leading capabilities throughout the whole additive value chain - from concept to finished component."

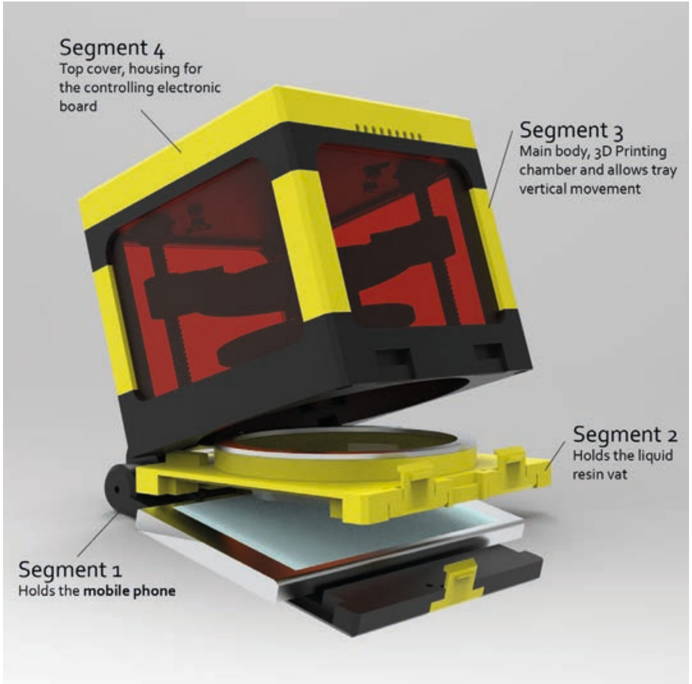
But Norrby felt confident all along that the guitar would pass Malmsteen's test. "I know my colleagues. They are world experts in what they do. When you put all this expertise together, we can create a guitar Yngwie will not be able to smash. That is something I'm sure of," Norrby said, weeks before the instrument was even completed.

"This guitar is a beast! Sandvik is obviously on top of their game."

Lumi Industries S.r.l. I Davide Marin

LumiBee



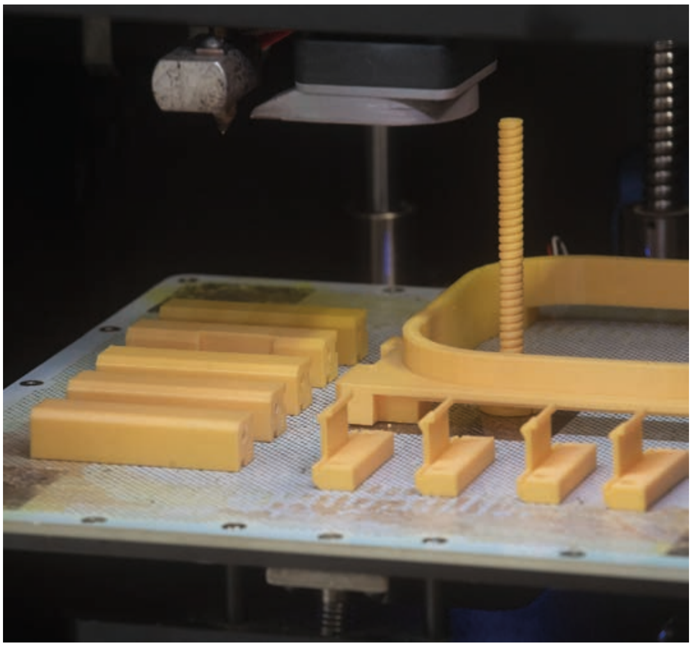


Inspiration

This project was born with the aim of making 3D photosensitive resin printing affordable. Daylight resin for 3D printing allows most cellphones to be used as a light source to polymerize the resin. This allows us to give a second life to slightly outdated cellphones. I decided to design a very compact 3D printer that uses this technology, and to make the production process as lean as possible, the LumiBee can be bought as a kit or built by anyone with access to another home 3D printer.

Unique Properties / Project Description

The LumiBEE is a unique compact 3D Printer that uses photosensitive liquid resin. It has been designed so that 95% of its parts can be printed with a desktop Filament 3D Printer. The LumiBee is also particular since it uses the screen of a mobile phone, inserted inside, to transform the liquid resin into a three-dimensional object. Its structure is modular, where segments, each with a specific function, can be modified and customized.



Production / Realization Technology

The 95% of the parts of the LumiBee 3D Printer can be produced with an FFM 3D printer. This means that the production of the LumiBee is very lean. It can be sold as a ready to use product, or as an assembly kit, or the user can even just purchase the digital files and produce the parts at home, as long as he/she has access to another low cost 3D printer. Many schools, maker spaces and laboratory offer the use of a 3D printer for free or for a low fee, so this is also an option for the user who wants to just by the digital files.

Specifications / Dimension / Package / Technical Properties

Size approx. 120 x 120 x 140 mm.

Challenge

One of the challenges was to optimize the design so that the production of the parts of the Lumibee (that are 3D printed) takes as less time as possible. Normally medium and big sized 3D printed parts take hours to be fabricated, so we went through many different iterations to minimize the manufacturing time.

Image credits: Davide Marin

The world's first 3D-printed diamond composite

Sandvik creates first 3D printed diamond composite

Sandvik Additive Manufacturing has created the first ever 3D printed diamond composite. While this diamond does not sparkle, it is perfect for a wide range of industrial uses. The new process means that this super-hard material can now be 3D printed in highly complex shapes and can thereby revolutionise the way industry uses the hardest natural material on the planet.

Diamond is harder than anything else in nature. It is a key component in a large range of wear resistant tools in industry, from mining and drilling to machining and also medical implants. Since 1953 it has been possible to produce synthetic diamond, but since it's so hard and complicated to machine, it is almost impossible to form complex shapes. Until now, production of super hard diamond materials only has allowed for a few simple geometric configurations to be formed. By using additive manufacturing and a tailor-made, proprietary post-processing method, Sandvik has managed to 3D print diamond composites which can be formed into almost any shape.

"Historically, 3D printing in diamond was something that none of us imagined was achievable"

The difference between Sandvik's diamond and natural or synthetic diamond is that Sandvik's is a composite material. Most of the material is diamond, but to make it printable and dense it needs to be cemented in a very hard matrix material, keeping the most important physical properties of pure diamond.

The opportunities are enormous

Due to Sandvik's use of additive manufacturing, diamond components can now be created application ready, in very complex shapes, without the need for further machining. This will open up the possibility of using it in applications that were previously considered impossible. "Historically, 3D printing in diamond was something that none of us imagined was achievable," explained Anders Ohlsson, Delivery Manager at Sandvik Additive Manufacturing. "Even now we are just starting to grasp the possibilities and applications that this breakthrough could have.

"On seeing its potential, we began to wonder what else would be possible from 3D printing complex shapes in a material that is three times stiffer than steel, with heat conductivity higher than copper, the thermal expansion close to Invar – and with a density close to aluminium. These benefits make us believe that you will see this diamond composite in new advanced industrial applications ranging from wear parts to space programs, in just a few years from now."

The 3D printing process

"The additive manufacturing process used is highly advanced," explained Mikael Schuisky, Head of R&D and Operations at Sandvik Additive Manufacturing. "We are printing in a slurry consisting of diamond powder and polymer using a method called stereolithography, where complex parts are produced, layer by layer, using ultraviolet light.

The step after the 3D printing is however even more demanding. This is where Sandvik has developed, a tailor-made, proprietary post processing method making it possible to achieve the exact properties of the super-hard diamond composite.

"Sandvik's 3D printed diamond composite is a true innovation. It means that we can begin to use diamond in applications and shapes never conceived possible before"

"This step was extremely complicated. However, after extensive R&D efforts and several trials we managed to take control over the process and made the first 3D printed diamond composite." "It was incredible to see what we can achieve when we combine Sandvik's leading expertise in materials technology with our strong capabilities in additive manufacturing and post processing," commented Mikael Schuisky. "We have some of the world's leading experts in both materials and additive manufacturing, which in a case like this can benefit many industries around the globe making it possible to use diamond in applications and shapes never conceived possible before."

"Rather than looking to actually develop completely new materials, today the big push within the industry involves the often-radical restructuring of existing materials," said Annika Borgenstam, Professor at the Department of Materials Science and Engineering at Stockholm's KTH Royal Institute of Technology.

"Using revolutionary new processes such as additive manufacturing will open up completely new ways of using the same types of materials that we have today, by building in the properties that we need." "Sandvik's 3D printed diamond composite is a true innovation. It means that we can begin to use diamond in applications and shapes never conceived possible before," said Susanne Norgren, Adjunct Professor in Applied Materials Science at Uppsala University.

"Just imagine what it could do to industries, when it is possible to print anything, in any shape – in diamond"

Sustainable with superior properties

Another key advantage of additive manufacturing is that it allows engineers to minimize material waste, making the technology more sustainable. The diamond powder in Sandvik's process can be extracted from the polymer in the slurry after the printing, and then be recycled and reused in another print-job. The diamond composite has been tested and found to have extremely high hardness, exceptional heat conductivity, while also possessing low density, very good thermal expansion and fantastic corrosion resistance.

"We now have the ability to create strong diamond composites in very complex shapes through additive manufacturing, which fundamentally will change the way industries will be able to use this material. As of now, the only limit to how this super-hard material can be shaped and used is down to the designer's imagination," Mikael Schuisky concluded.

Facts

- Diamond is harder than anything else in nature.
- Sandvik's 3D printed diamond composite was created using the additive manufacturing process called stereolithography, where complex parts are produced, layer by layer, using ultraviolet light.
- A slurry containing diamond powder and polymer is used in the process.
- After the printing, the next step in the process is even more demanding. This is the critical step where Sandvik has developed, a tailor-made, proprietary post processing method that is able to produce the exact properties of the diamond composite.
- Excess printing slurry can be reused to reduce waste – and the diamond powder can also be extracted from the slurry and then recycled, making the method more sustainable.
- Sandvik has a patent pending for the diamond composite process.

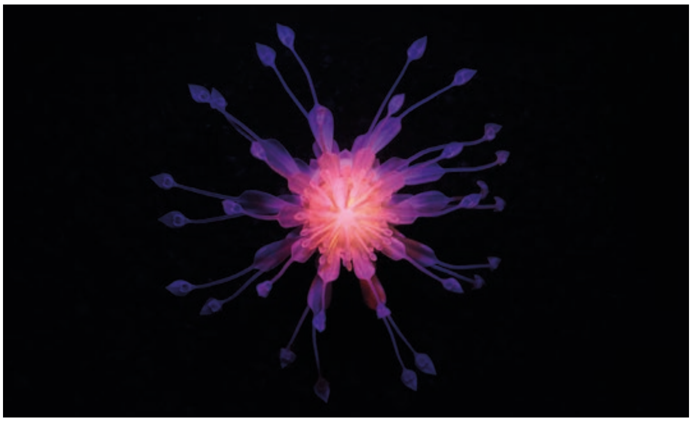
For more information (and a film) visit: www.additive.sandvik/diamond

Victoria University of Wellington I Nicole Hone

Hydrophytes - 4D Printing

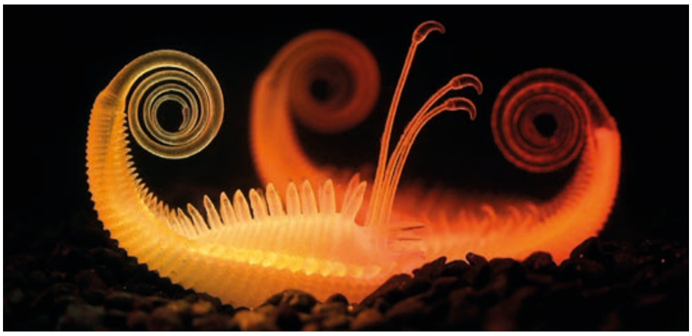
Description

The Hydrophytes are a series of five futuristic aquatic plants created as part of an industrial design master's thesis. They showcase an innovative approach to designing organic movement with multi-material 4D printing. With the added dimension of time in 4D printing, the designer's role extends into choreographing the performance of objects. Blooming, stretching and snapping like intelligent creatures, the Hydrophytes embody surreal hybrids of terrestrial flora and oceanic fauna. These Hydrophytes are created with Stratasys PolyJet technology that allows blends of rigid and flexible resins to be printed within a single object, known as digital materials. Despite the presence of this technology over the last decade, few have fully utilised the opportunity to create variable flexibility or explored the unique behavioural qualities of digital materials. The Hydrophytes demonstrate a range of complex organic movements and personalities, previously unexplored with PolyJet technology and challenging to create with traditional manufacturing methods.

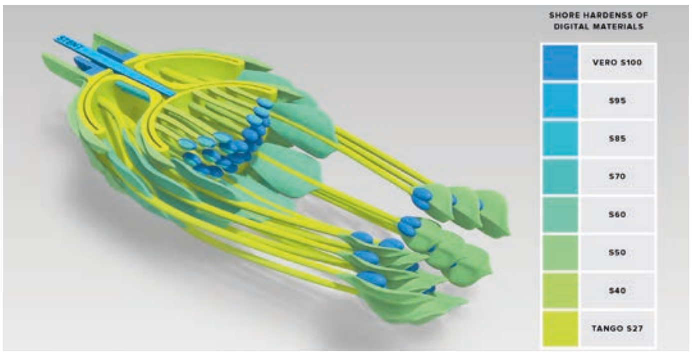


The concepts are 3D modelled using Rhino and Grasshopper with ZBrush. This allows control over the shape, surface texture, inner structure and material combination. Each design has a sealed chamber which enables it to activate independently through pneumatic inflation. For the film, the 4D prints are connected to a series of hand-held pumps, submerged in water and given the addition of colour through an LED projector. Contextualised within the film, the Hydrophytes encourage thought about the health of our future climate and the role of design in connecting man and nature.

These Computer-Generated Objects (CGO) take advantage of both the digital world, with its versatility and efficiency in form-making, and the physical world, where objects can respond to the environment, humans and other printed objects. This response happens in a way that is natural and conforms to the 'rules' of real life as opposed to computer animation. The project brings the digital and physical worlds closer together for the designer and audience alike. With the alluring visual effects seen in movies, there is a desire to reach out and touch the objects behind the screen. The Hydrophytes represent the new concept of Tangible Animation; bringing objects to life in the same world as the audience with multi-material 4D printing. This new technique is advantageous for the film and exhibition industries where immersive experiences are a growing trend. Film props created with this technology could help prompt genuine reactions from actors. Cinematic 'magic' can be transformed into authentic physical encounters within theme parks and offer multi-sensory experiences in educational settings such as museums or aquariums.

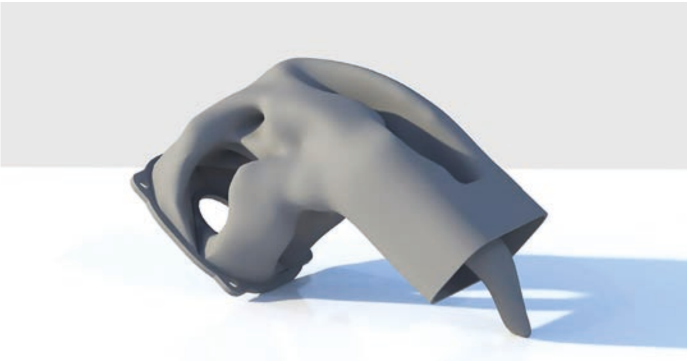


This project shows how the world of 3D/4D printing is entering exciting territory where objects can be created with compositional and dynamic qualities akin to natural biology. To view the Hydrophytes please visit http://vimeo.com/nicole-hone/hydrophytes-4d-printing. The film is true to life, with no effects created in post-production.



"The Mighty Duct"

(HP Jet Fusion 3D Printer air duct)



"The Mighty duct" – How 3D printing can improve a 3D printer

The core printing engine of HP Multi Jet Fusion technology is powered by HP's proprietary Thermal InkJet print heads. A series of ducts are often used to cool the print heads and achieve their optimum temperate range, enabling HP Jet Fusion 3D printers to function reliably over time.

HP has already used HP Multi Jet Fusion (MJF) to consolidate parts and reduce assembly and part costs for its own products. Now, thanks to the latest Siemens software (Siemens NX and Simcenter) it is possible to reinvent fluid management design, by optimizing the flow efficiency of the intake duct.

With the new design – the duct performance (and therefore, its value) increased – with an 22.3% improved air mass flow* - and without an increase to the cost.

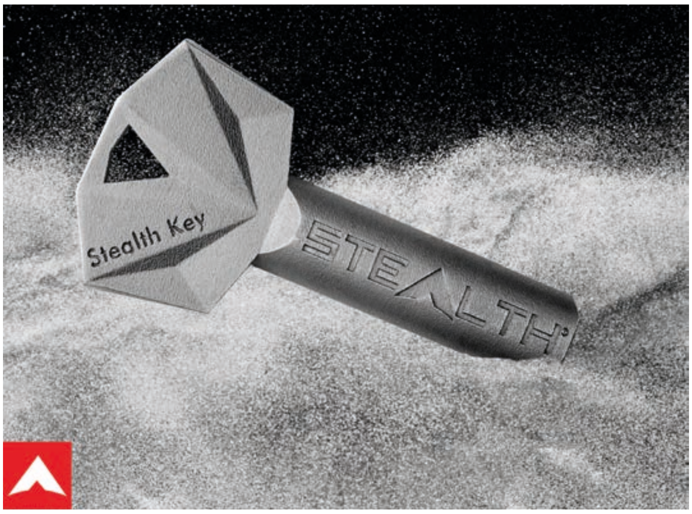
In addition, the end-to-end solution enabled a 75% faster development time versus Injection Molding - with production lead time reduced from 4 months to 4 weeks.

Designer's name: Samuel Jeong
Official product name: HP Jet Fusion 3D Printer air duct
Product dimensions: 110mm x 120mm x 80mm

* 5.5 and 5.8 PSI for left and right air duct air mass flow with the HP Jet Fusion 5200 Series/optimized design vs 4.6 and 4.7 PSI with the previous design.

UrbanAlps AG I Dr. Alejandro Ojeda

Stealth Key



Keys are only produced in-factory with aerospace technology. No key blanks, no electronics, no magnets. Just smart, simple and cutting edge engineering.

Smart. Simple. Seriously secure.

3D printing threats and Stealth Technology the risk and the solution
Your organisation is vulnerable. Only this time the threats aren't digital but physical. While your brightest talents build impenetrable defences to protect your organisation from cyber risks, the perimeter security that safeguards your company's most valuable assets is under threat. Any individual can infiltrate your organisation, gain access to your high security keys using simple and readily available 3D printing technology and duplicate them without trace.

For millennia keys have essentially been sheets of metal with holes, today thanks to 3D metal printing, the mechanical security key can be turned inside out and deliver unparalleled levels of duplication security.
Stealth Technology harnesses the power of industrial 3D metal printing to deliver superior key copy protection. Employed in the production of high strength components for satellites, jet engines and gas turbines, UrbanAlps' advanced technology is a key component in providing an unrivalled, market leading mechanical key solution to mitigate duplication risks.

Providing the highest level of security protection, Stealth Technology provides a physical key and cylinder system, where the code is neatly hidden under robust narrow ledges to avoid duplication. For our clients, this provides ultimate confidence that their high security keys are unscannable and work independently of digital systems. Our market leading solutions can be retrofitted to existing doors and locks to prevent physical security breaches.

Hidden codes

Stealth Technology employs state of the art 3D metal printing technology to produce physical superalloy keys where the codes are completely concealed ensuring maximum protection from duplication. Hiding the code under the narrow edges ensures the key code cannot be photographed or scanned. Keys are custom made and individually coded.

Proudly engineered in Switzerland

Founded by pioneering Swiss engineers with aerospace expertise, UrbanAlps' advanced Stealth Technology fuses clever engineering with innovative and detailed craftsmanship to deliver game changing security. Stealth Technology can be found in all of its mechanical key and cylinder applications, as weil in the company's superalloy Stealth Padlocks.

Purely mechanical

Stealth Keys are produced by laser melting layers of superalloy powder, the same technology used in the production of high strength components for jet engines and gas turbines. This purely mechanical solution requires no electronics or magnets, just smart, simple and reliable mechanics.

Trusted solutions

Today, conventional keys provide little barrier to unauthorised duplication by 3D printing. This exposure has driven many organisations to add layer upon layer of expensive electronic security, increasing the risk of reliability issues as weil as additional security exposures. In some security scenarios using keys reliant on chips, network access, batteries and other digital systems is simply undesirable, unreliable and creates digital vulnerabilities of their own. The patented Stealth Key provides maximum duplication security, which can be used either in combination or independently of other digital solutions.

Your enterprise partner

Developed in its advanced engineering labs in Zürich Switzerland, UrbanAlps' patented Stealth Key employs 3D Metal Printing technology, high-end manufacturing for high-end security. Stealth Keys look and function like traditional mechanical keys but unlike common keys their unique design offers superior levels of protection against unauthorised duplication. Custom made cylinders fits standard European, US and Scandinavian profiles. Two factor authentication such as chips and sensors can be added to Stealth solutions, however the core benefit is the key's standalone security profile. The company is currently engaged in a number of projects across Europe with firms seeking to update their security solutions with Stealth Technology. With offices in Zürich, Dubai and Hradec Kralove (the Czech Republic), UrbanAlps AG is experiencing rapid growth to respond to the increasing demand. Our high-tech company structure enables us to offer flexibility, customisation and scalability for those organisations seeking ultimate confidence in mechanical keys as part of their security architecture.

Laser based serial production

- Exclusively made in factories
- Custom made cylinders
- Custom key branding
- Master keying and keyed alike possibilities
- Coloured key head for easy identification
- Individual key labeling

High risk sectors

- Energy and utilities
- Governmental assets
- Oil and Gas
- Military facilities
- Data centres and corporations
- Border control & Airports
- Secure Transport & Logistics
- Manufacturing facilities

Video: www.youtube.com/watch?v=xr28yph_BPs

Vestas (manufactured with Avid Product Development) I Jeremy Haight

Web Sling-Jaw

Vestas clamp for wind turbine rotation

Vestas is the energy industry's global partner on sustainable energy solutions. They design, manufacture, install, and service wind turbines across the globe, with 105 GW of wind turbines in 80 countries.

Wind turbine blades are 67+ metres long and require a tool to rotate the blade component (structural shear-web) from horizontal to vertical. This application serves as a safety aid to mount and protect the turbine blade component during handling. Although this is a reusable part, some of these parts may need replacing every year – therefore, short runs are required. Looking for optimal performance, Vestas partnered with Avid Product Development to source and manufacture the part with a new material - BASF ULTRASINT™ 3D TPU01 - and produced it with HP Multi Jet Fusion technology (MJF).

Whilst PA 12 and PA11 parts typically break due to handling conditions and high-compression during use, the new BASF ULTRASINT™ 3D TPU01 successfully absorbs impact and protects the blade components from delamination and crushing due to strap tension bounding the component edges.

This AM part is unique in that it both:

- Utilizes a surface optimization and directional latticing to concentrate strength in the heel-area of the part. Stiffness is needed here, in order to transfer the torsion load from the strap engaging the flange edges into a compression load which is redirected to the web main-body, where it's distributed across the larger cross sections of the box-beamed area of the laminate that can handle the stress best.
- Has great ductility (on the thinner, cross-connection of the printed part) across the top-face of the flange so that the compression in this region is easily absorbed and the connection does not fail. It is capable of light buckling without yielding or pushing into one side of the flange edge or the other which could damage our parts.

This means that elements can be designed to have both high-strength and rigidity in the required areas, while also having areas that can buckle yet not yield in areas where we don't want it.

Without additive technologies, it would not have been possible (or cost or time effective if using IM) to produce this type of part – with both of the abovementioned mechanical advantages. HP MJF technology specifically delivers the full isometrics strengths and enables production with the new BASF ULTRASINT™ 3D TPU01 material.

Injection Molding was ruled out due to the time and cost implications. Conventional machining methods were not an option in TPU or similar elastomers/polymers and would have resulted in an 86% higher cost for a semi-ductile material with close to similar impact resistance.

Results

Time:

- +45 minute cycle-time reduction on every part
- TTM/ time to manufacturing is 2% that of conventional Injection Molding (3-4 days vs. 3-3.5mo)

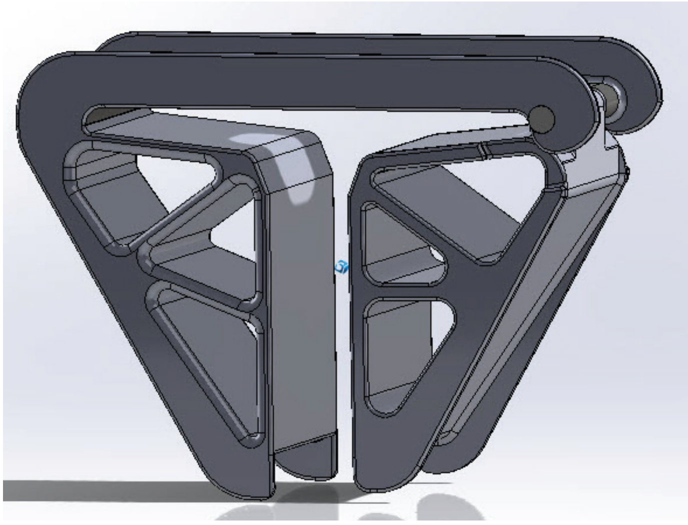
Quality:

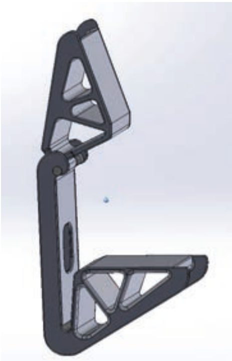
- CoPQ metrics of the part improved by 23%.

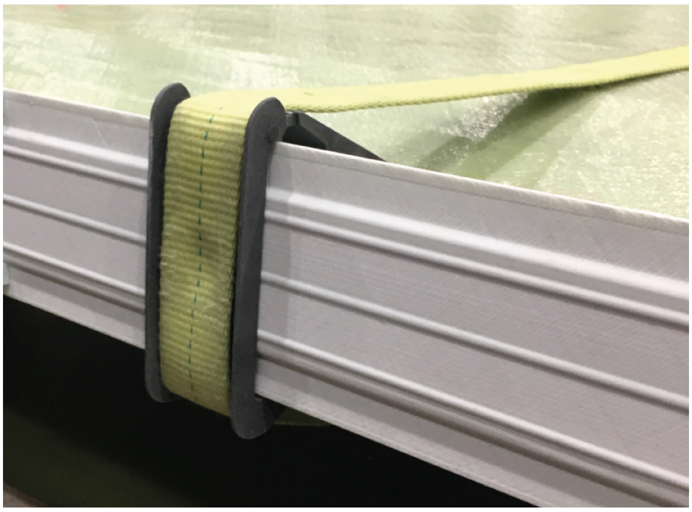
Cost:

- Estimated ~20% savings compared to Injection Molding (when considering amortized tooling expenses)

Designer's name: Jeremy Haight
Official product name: Web Sling-Jaw
Product dimensions : ~ 175mm x 130mm x 65mm

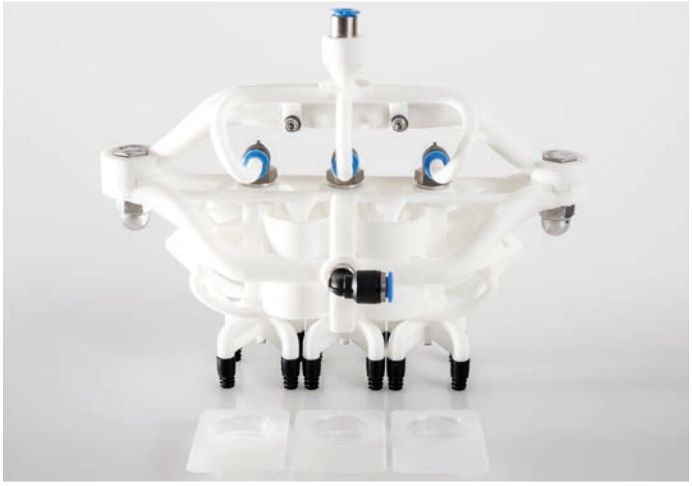






Harro Höfliger Verpackungsmaschinen GmbH I Nico Hjordt

Additiv gefertigter Spreizkopf



Summary description of the product

The submitted concept is used for the expansion of contact lens blister packs. The blister packs piling up on the in-feed belt are picked up by the expanding head and then inserted into a packaging machine after being expanded by 2.5 mm. The system is transported by a delta robot that the expanding head is attached to. The concept was developed as part of a Bachelor's thesis.

The state of technology

Current contact lens packaging machines expand and transport the blister packs using a conventionally manufactured assembly. The transport process is implemented using a servo-operated linear axle. An expanding head made from multiple, conventionally manufactured components is mounted on the axle (figure 1).


Fig. 1: Conventionally manufactured components

Motivation

The conventionally manufactured expanding head is made from a total of 560 individual parts, including eleven different production parts. The goal was to replace the expanding head with a single component made using additive production. This substantially reduces the amount of time required for assembly. The internal process costs are reduced by reducing the number of production parts. This also reduces the procurement costs.

Concept

The concept is based on an expanding head made from PA12 using SLS, with integrated bellows to facilitate the expansion process. Travel is limited by an integrated stopper. A single expanding head can pick up three blister packs. Development made use of the finite element method in order to achieve the maximum possible fatigue resistance. The final design of the expanding head was arrived at following multiple iteration cycles in the design process. It was successfully tested in trials.

It is necessary to combine multiple expanding heads in order to transport the required number of blister packs. That is why the "cobweb" was developed. This is responsible for the central distribution of pressurised air, and lends stability to the design (figure 2). The pressurised air and vacuum suction are not distributed using pneumatic tubes, as is usually the case. The tube is integrated into the cobweb. The thin-walled structure is sufficiently elastic to compensate for the motion of the expanding head. An integrated plug-in system allows the air-tight joining of the components (figure 3). Sealing is provided using O-rings, which reduced the total number of parts even further. There is no need for the time-consuming assembly of pneumatic screw connections or the connection of pipes.

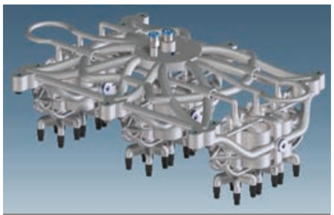


Fig. 2: Additive manufactured components

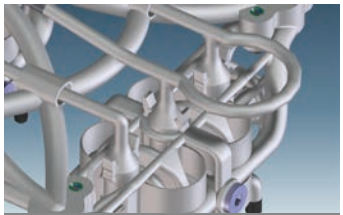


Fig. 3: Integrated pneumatic functions

The entire assembly requires just two pneumatic screw connections. The integrated conduits shown in red in figure 4 supply pressurised air to the bellows, while those shown in blue are for the vacuum suction.

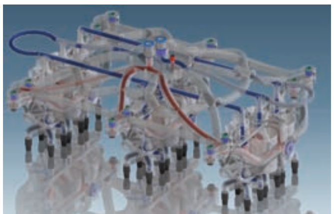


Fig 4: Internal pressure conduits

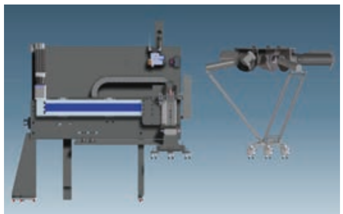


Fig 5: Comparison conventional and additive

Reducing the weight by a factor of 10 in comparison to the conventional version means that the expanding head can be moved using a delta robot (figure 5). This also significantly reduces the amount of time required for assembly. Internal procurement processes benefit from a substantial reduction in the number of parts purchased and produced. The cycle time is improved, which means that the assembly does not need to pick up as many blister packs at once.

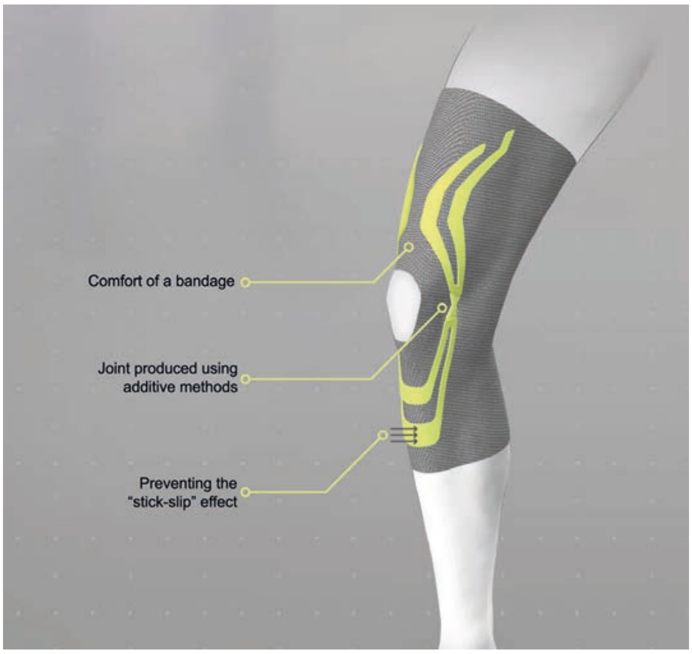
Testing

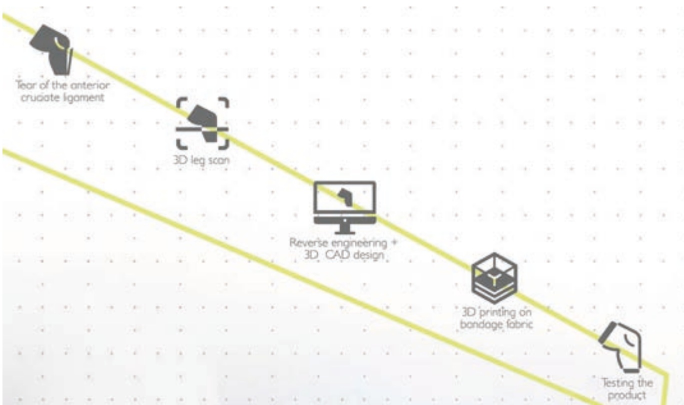
The function of the expanding head was successfully tested in trials using a prototype (figure 6).


Fig 6: Successfully tested prototype

Technische Universität Dresden I Dustin Ahrendt I Arturo Romero I Emese Papp I Felix Schmitt

GENUINE





Concept

Tearing the anterior cruciate ligament affects the stability of the knee joint. This results in the "stick-slip" effect, which causes the shinbone to shift relative to the thigh. Following the post-operative use of a hard-frame orthosis, GENUINE combats this effect and promotes the healing of the musculoskeletal system. It is produced specifically for each client on the basis of 3D scanning data, allowing it to be tailored perfectly. Thus, the innovative new aid achieves an outstanding combination of functionality and comfort.

Motivation

Movement and exercise are essential parts of our daily lives, and crucial for a high quality of life. Unfortunately this poses a risk of injury to our joints in particular. Tearing the anterior cruciate ligament is the most common of all knee injuries. An innovative new aid has been developed to support the post-operative healing process.

Innovation

GENUINE is a made-to-order, unique combination of materials consisting of a textile bandage and reinforcing orthotic elements made using additive production. Printing these elements directly onto the bandage fabric means that conventional textile joining methods such as sewing, gluing or bonding are no longer necessary. The use of computer-based processes makes it possible to adjust designs quickly and efficiently. The integration of additive production into the textile and clothing technology allows product design, cut design and 3D printing to be combined. GENUINE goes above and beyond conventional 3D printing by combining pliable, flexible materials with rigid, application-specific elements. The integration of continuous carbon or glass filaments enhances rigidity while keeping the weight low. The product can also be manufactured economically in non-standard batch sizes of one. This allows the healing process to be supported at any age, and for children in particular.

Viktoria Frank

Design of an intelligent orthosis in support of the locomotor system

Concept description

The „intelligent orthosis" project started in september 2018 in cooperation with the MCI Management Center Innsbruck - department of mechatronics and shows a new solution to the approach of how an intelligent orthosis can make everyday life easier for cerebral palsy patients in the future. The main problem of the target group is the muscle weakness/drop foot, which leads to a deviating gait pattern and a decreased walking speed.

During the master thesis project, contact was established with a cerebral palsy patient, who volunteered. Through this contact with this „specific user", a further problem was identified – namely reduced muscle activity of the leg. Due to the minimal lifting in the „swing phase" of the leg, many patients´ feet are angled inside which causes unstable ground contact. Together with a group of students [4] from MCI's bachelor class, the first technical and functional principles were selected, which focused on these two problems. In summary these are the drop foot and the foot's angulation before ground contact (toe-out angle correction). This mechanism of correction must be activated in a few hundreds of milliseconds during the swing phase (foot has no ground contact) in order not to restrict the patient while walking. The hip position is only detected by sensors and is not actively supported by a further motor. The user receives passive feedback from vibration motors. Due to this passive, non-motor support, the patient has the possibility to correct the deviation by himself (training function). Various sensors (gyroscope, acceleration sensor, pressure sensor, encoder,...) can be used to evaluate the angle of the hip and knee position. For example, an encoder detects the hip position. The project was limited to the reference leg (patient's right leg). The product is operable by a smart phone app and enables the patient to choose individual settings for active motor support or to switch on/off the passive feedback.

In course of an observational gait analysis (RLANRC-system - 8 gait phases) a third problem could be analysed, due to an intensive muscle research, namely a balance problem results from muscle weakness, especially in the monopod phase. Two additional air cushion pockets (foot sole area and calf area) counteract the patient's sense of equilibrium in a sensory way through targeted air support. The intelligent orthosis presents a good mixture of an active motor support and a training function (passive feedback). By an intensive investigation on the cause problems of the foot lift weakness, a purposeful solution strategy could be defined. The conclusions of the research, the problem definition, the analysis and the subsequent expert talk were fundamental for the new design. On the one hand, this is made possible by patient-oriented methods (3D scanning) and, on the other hand, by production methods that will be used in the future in order to have the product manufactured fast and affordable (3D printing). Furthermore, the design ensures an improved attachment to the leg, user-friendly handling and the courage to distinguish itself from conventional medical products. The concept looks about 10 years into the future, due to the still not available dimension of the rotary motors.

[4] (Abfalterer, Mattias / Achenrainer, Sandrino / Figl, Alexander / Frei, Max / Heinrich, Nils / Neubauer, Vanessa /Payr, Johannes / Rieger, Marcel / Robertshaw, Clare Gwenyth / Seiler, Felix / Wimmer, Doris) advisor: FH-Prof. Yeongmi Kim, PhD (2018): „Medical Device Project." MCI Management Center Innsbruck - Department of Mechatronics) project material and results of the cooperationproject at MCI Innsbruck

Advantages for the future

Many different diseases result in a limitation of the walking ability. Cerebral palsy (ICP), CMT/ HMSN, Rheumatoid arthritis, MS multiple sclerosis, ALS Amyotrophic lateral sclerosis, Guillan-Barré syndrome, Morbus Parkinson, Hemiplegia,... In general the target group for the „intelligent orthosis" should in principle be able to walk, has slight muscle weakness, slight spastic paralysis or a slight loss of control of the locomotor system. An important role in the course of the thesis was to rethink the production method to reach a patient-oriented adaptation, more efficient and cheaper production. The base frame has the task to connect the compressions textile and the actuators and will be produced by laser sintering production method. Every patients´leg is individual and needs a special adaptation to achieve a good fit for the user. Because of ergonomic aspects which concerns to be an asymmetrical shape, series production is not the optimal choice. The product needs to be customized in the future. It needs to be considered that thermoforming established as a conventional production method in the field of orthotics. Compare to the new production-process-solution-strategy it takes a lot of time (including the post-processing time).

Production-process-solution-strategy:
The first step starts by scanning the patient´s leg within a 3D scanning device. This evaluation of the complex surface is quite fast, has a good result and no body contact is needed anymore. In the next step through algorithmic analysis of 3D body measurements, six different parameters can be defined and adapted on the base frame 3D model. Automatically due to this parametric data, the new individual base frame is generated and a control loop with FEM-analysis take place. This analysis has a great influence on the choice of material. In the future, this scanning process shows great potential to customizable orthosis based on 3D printing technology.

Variable parameters:
In summary, six important variable parameters (including the material selection as a parameter) are defined for the base frame. As already mentioned, the weight can be varied from patient to patient. Parameter 01, 02 and 03 focusing on weight adaption and stability. Another parameter to gain better stability results is to adapt the wall thickness. The „size adaption" will be adapted by parameter 04 (shoe size and high adjustments). Three different circle diameters can be evaluated by parameter 05. The „shape contour of the leg" is a further specific parameter which needs to be measured to achieve an ideal result.

In conclusion the specific parametric details for an individual adaptation to the base frame are:
parameter 01 - material selection
parameter 02 - wall thickness adaption
parameter 03 - classes of compression stockings
parameter 04 - shoe size & high adjustment variabilities
parameter 05 - specific characteristics of the diameters of the leg identified by three different circles
parameter 06 - unique shape contour of the leg

Material selection criteria:
The laser sintering (SLS) production method shows a new solution to the application. This method allows cheap and individual production. PA 12 shows optimally properties for the tensile strength, elastic, acid-resistant properties and other required characteristics. 3D printing technology enables an easy change of materials and colors for individual preferences of patients´. In case more stability is required due to higher body weight, PA 12 can be replaced by further materials like Windform material®, PA 6, PA 6.6 or fibreglass-reinforced composites. This lead to the advantage of flexible operation in the future.

Victor Olsson

Ti64 biathlon rifle stock

The world's first 3D printed biathlon rifle stock

Background

Traditionally the biathlon rifle stocks are made out of wood, so has it always been and there is some assumption that it is also how it should be so. This is still the case with a few exceptions from some manufacturers working in various composites and carbon fibers. Today, the rifle stocks are manufactured by hand or with the help of various Computer Numerical Control, (CNC), machines, Additive Manufacturing, (AM) is not a widely used method. It is mainly used for the manufacture of smaller parts for the rifle. I am a student at a BSc education focused on product development, which is where I was first introduced to AM. Early in my education there was an interest in AM, I quickly saw an opportunity to combine AM with my competing in biathlon. I started optimizing smaller details for biathlon rifles that I then used for competitions. My details were developed from prototypes to finished products that have been used at the Olympics, World Championship and the World Cup. As the smaller details started to become finished products, I continued to challenge myself and the standard in biathlon for the possible used for AM in the sport. I had a dream to make a functioning rifle stock that is completely manufactured with AM that I can use in competition. My first thought was to make my stock in plastic, but I came in contact with Aim Sweden, (Östersund, Sweden), a company specialized in AM. They gave me the opportunity to manufacture my rifle stock in the alloy Ti6Al4V with a powder bed method, Electron Beam Melting, (EBM). So began my work towards the world's first 3D printed biathlon rifle stock in titanium.

Design

In the beginning the biggest design challenge was to make a drawing that would fit into the printer's building plate while being in line with the weapon system's attachment, International Biathlon Union's, (IBU), rules and the dimensions I need to be able to shoot with the stock. The stock had to be divided into three major main parts, two smaller moving parts and four small brackets (nut bracket for butt plate/cheek support and part of the bracket for the carrier harness) for it to be manufactured. The limited building volume also created a new opportunity, namely the opportunity to make minor changes to the parts concerned instead of having to manufacture a brand-new rifle stock as soon as any changes is to be made. Each part of the rifle stock is made up of two parts, a solid "frame" and a "mesh" part which are merge together and printed as one part with EBM technology.

In addition to the nine titanium parts, the rifle stock consists of twelve parts printed in Pa 2200, (nylon), using a powder bed method Selective Laser Sintering, (SLS). The twelve different parts consists of three handgrips (pistol grip, standing grip and prone grip), cheek piece, system embedding (where the weapon system rests against the stock), four magazine holders, two hooks for the butt plate (which determine the position of the shaft on the butt plate) and finally part of a bracket for the carrier harness. Like the titanium parts all plastic parts (except the system embedding, magazine holders and bracket for the carrier harness which consists of only one solid part) are also made up of a solid and a mesh part which is merge together to one part before being manufactured. The solid frame creates stability for the construction where the mesh act as a shock absorber and to reduce the weight of each part.

Before the titanium parts were manufactured in the EBM printer, three different prototypes were made in Pa 2200 printed with SLS technology to ensure that all parts fit together and get a picture of how everything will look. Between each plastic prototype, necessary modification was made to the drawings. All handgrips are first cast in clay to get an exact copy of the shooter's hands. Then a 3D scanner was used to scan the molded grips to get a digital copy of the surface that will become the shooter's grips. The scanned data files are modified and divided into solid/mesh which is then merged together and printed.

Design requirements for the rifle stock:

- Ability to easily adjust settings for the shooter.
- The total weight of the rifle <3,5kg, (IBU's minimum weight for a competition rifle), to be able to balance the weight in the right places for optimal balance. The balance is more important in a lighter weapon as it is more stable to shoot with a heavier weapon, but the heavier weapon makes it harder to ski.
- Small wind-up area to reduce wind's impact on the rifle.

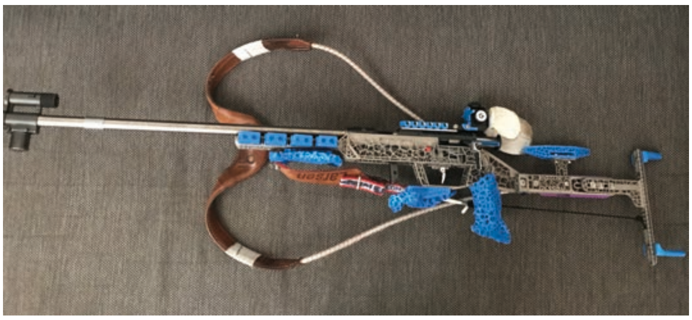
Design solutions for design requirements:

- Adjust to shooter:
  - o As the stock is based on three main parts it is possible to make changes and change parts to suit the shooter.
  - o Molded grips shaped after the shooter's hands.
  - o The cheek piece can be adjusted in three stages independently of each other.
  - o The length of the butt plate can be adjusted.
  - o The hooks on the butt plate can be adjusted independently to change the position of the shaft on the butt plate.
  - o The position of the prone grip can be adjusted along a rail and the height/angle can be adjusted with spacers.
- The total weight of the rifle is approx. 3,4kg so the rifle is balanced with 100 grams to reach the minimum weight.
- When the stock is made from titanium, the wind-up area can be reduced, even the mesh construction allows the wind to blow through the stock.

The technology of the future

I think this is the technology of the future of individual adaption in sports equipment. Not only in biathlon but also other sports can benefit from personalized equipment. I think biathlon is a sport that can really leverage this technology to improve athlete's performance. Because the 3D technology can help the practitioner to design equipment as the rifle exactly accordingly to their wishes. Much of the rifle's optimization today depends on the athlete's ability to communicate their wishes.

This stock is among the more expensive on the market, it is primarily an expensive investment cost to design all the drawings and also the manufacturing cost of the parts in titanium. But the stock takes the individual adjustment to a new level. It also has a clear advantage if something is to be changed, replaced or broken. Then you can print exact copies of the affected parts from the delicate drawings or make a new part where only the part with a change is replaced. Instead of what it looks like today, the whole stock is often replaced when any major change is made. That opportunity, in turn, saves both time and money. It is also a manufacturing method that is constantly evolving which can lead to cheaper manufacturing costs. This means that it is a technology that is becoming more and more accessible and can be used to a greater extent.



3D Printed Mountain Bike Frame

Description

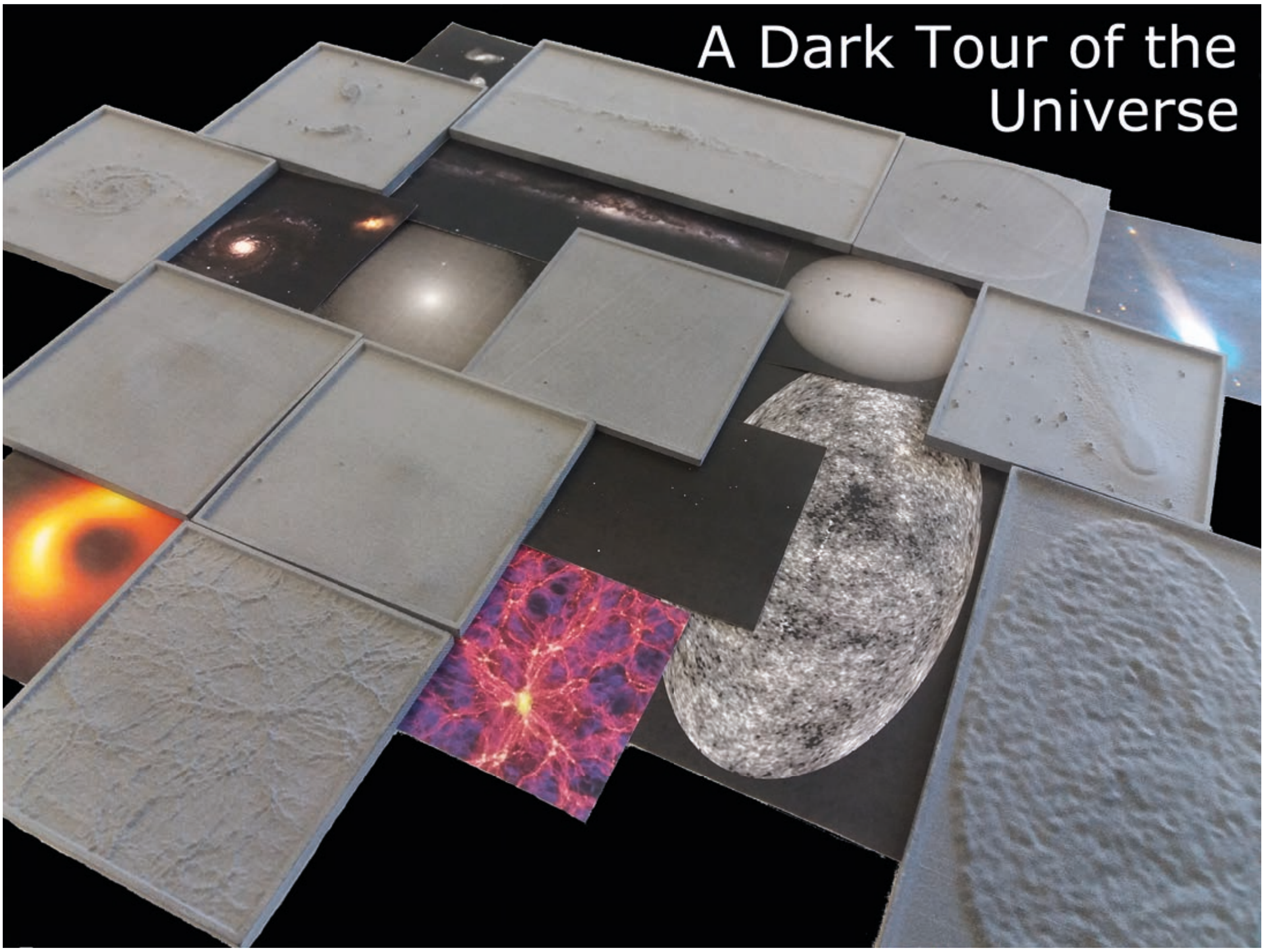
A mountain bike frame 3D-printed seamlessly in two parts consisting of the swing-arm and the main frame. This frame is designed to be printed on the Aeroswift SLM machine in South Africa in Ti-6Al-4V utilizing their extremely large bed size (2mx0.6mx0.7m).

Due to the extremely high cost of top of the range mountain biking components, this design could possibly compete with the high-end carbon fiber designs economically. Furthermore tools such as Topology Optimization as used in this project increase it's weight/stiffness competitiveness as 3D-Printers are not limited to single/split draw mold constraints like carbon bikes are.

This will be the first time a SLM bicycle has been printed without welding sections together and will be one of the largest metal 3D-Printed objects ever.

BMW Group I Martin Friedrich

A Dark Tour of the Universe



Description

The purpose of the "A Dark Tour of the Universe" is to give people with visual impairments the ability to experience space through sound and touch.

Danny Giebitz I Jasper Precht I trinckle 3D GmbH

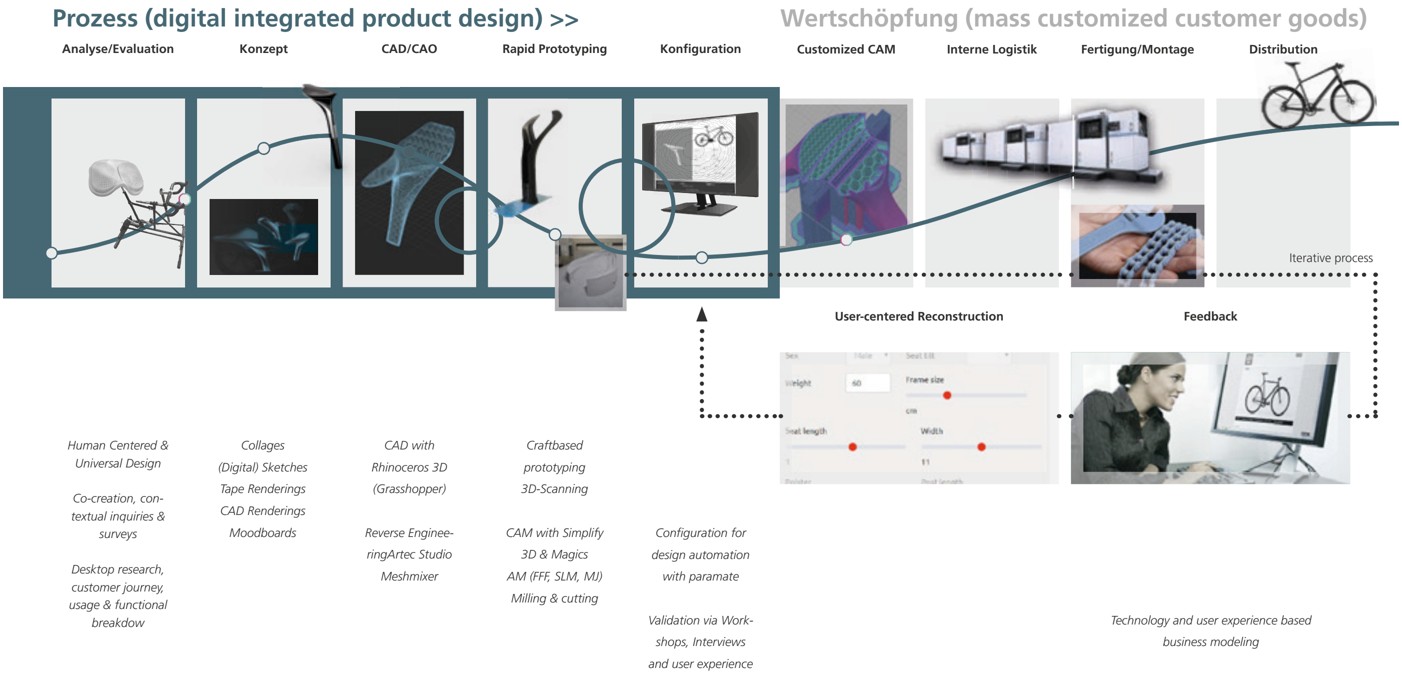
Sitti.gh

Additive production in the product and industrial design of user-specific bicycle components based on the example of a bicycle saddle

The result is a digitally integrated action routine for products with high standards of customisability. These are created using web-based CAD configuration systems, and implemented using model making or 3D-printed, which means that many of the components are no longer necessary. Additive production is a computer-based production technology based on formless materials. The significant difference in comparison to other CAD-based production methods is the creation of a piece without the use of semi-finished products or tools, and is therefore generative/additive rather than abrasive. This allows the designer to create objects with a higher degree of complexity and free form. The enhanced freedom of design and the field of technology form the foundation of this work. At a design level, the attributes that are taken into account to differing degrees are functional integration, functional transformation and component reduction. Customisation mechanisms are integrated at the user-specific level.

The design thinking methods used for this purpose are mass customisation, human-centred design and design automation. The seat assembly shown is based on consolidated relevance and feasibility with respect to the degree of customisation and ergonomics, taking into account the personal aspect of practicability in terms of time.

Procedure - Workflow and added value

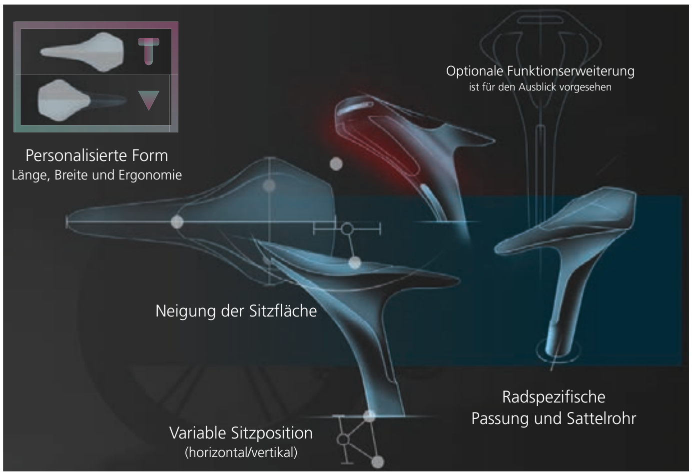


Challenges with respect to the process

- In cases where the batch size is 1, it is advisable to base the position on overhang areas of 45 - 60% -> reduction in volume of material: 63.7% -> time saved: 71%
- Increased batch sizes and new facilities (utilisation of installation space) have a positive impact on costs, thanks to savings of up to 85.7% for the production process
- The use of recycled materials does not have a negative impact on the component's properties.
- The quality of materials corresponded to the information provided in the data sheet, and usually contributed to process-compliant production.
- The materials used are inadequate for durability in use.
- The selection of functional materials available is currently quite limited. Only three or four usable materials were found during Formnext 2018, although according to the manufacturers they were not yet available.
- The price of the materials used is up to ten times higher than the conventional equivalent.

Use analysis

Character & Shape



Added value for multiple target groups

- Functional integration
- Component reduction
- Free-form design
- Reduction of material input
- Customisation
- Production based on need, from a batch size of 1
- Substitution and customer retention
- Simplified increase in complexity

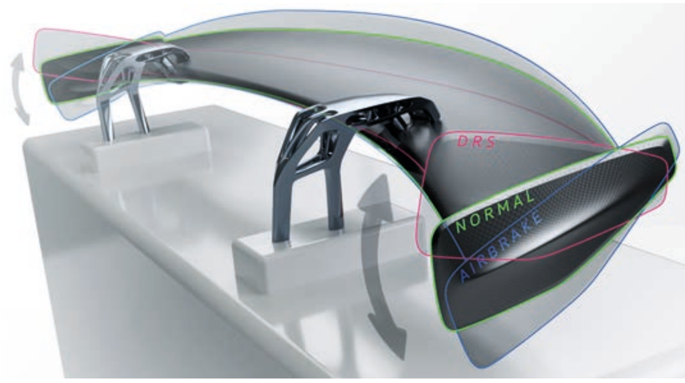
EDAG Engineering GmbH I Fabian Baum I Sebastian Flügel I Martin Rüde

WING3D

Description

The WING3D system combines lightweight construction, active aerodynamics, functional integration and a visually appealing design with the help of additive production.

The active spoiler system is characterised by a bionic aluminium mount, produced using laser melting. The mount holds the prototype 3D printed spoiler and adjusts its position by means of integrated hydraulics. This could not be manufactured using conventional methods. The system is operated by a piston with oil pressure of up to 90 bar. This piston can set the spoiler at any angle between 6° and 42°, allowing it to be adjusted to the driving situation in terms of drift and resistance, in addition to an aerodynamic braking function. A 3D printed slide bearing insert reduces friction and facilitates zero-maintenance kinematics. An electric wire is integrated into the mount for a sensor to determine the positioning/angle of the spoiler and an LED brake light.



The "WING3D" system is optimised for lightweight construction, while also meeting the strict structural requirements for real applications. The focus was also on improved aerodynamic properties and a visually appealing design. The latest findings and methods from the BMBF-sponsored research project "OptiAMix" were applied to the multi-objective optimisation.

The system is designed as a small-run series application for sports vehicles, and could be offered ex works or as a retrofit solution in the future.

Ganit Goldstein

Shifted Craft

3D multi-color printed shoes with hand made techniques

Collection of two pairs of shoes collaborating with Stratasys LTD with extraordinary research working method of printing directly on leather with Polyjet technology. The collection combines traditional shoe making processes with additive manufacturing to make new approach of producing shoes in a hybrid working method. The working method of inserting leather to the 3D printer allows to print multiple parts without the need of support or connectors in the printing process. It allows the using of minimum materials because the fabric is the base of all the printed parts. The collection was designed using a combination of 3D scanning and parametric modeling software. The final pieces were 3D printed in partnership with Stratasys Art, Design and Fashion department and R&D team using its multi-material and multi-color J750 3D printer.

The shoes printed as 3 different parts, and assembly together with traditional craft processes for a 'Human and machine' workflow.

Concept

The Hybrid of Craft and Technology is essential part of 'Shifted Craft' collection. Describing a balanced point of view by examines the connection between technology and tradition through a combination of two creative worlds: handicrafts - traditional shoe making, and computer engineering - 3D design and printing. The collection aims to highlight the relationship between the body, form and technology and draws inspiration from a traditional Japanese yarn and fabric dye technique called 'ikat'. 3D printing with Multi-color ability enables a verity of endless color-matching and freedom of design with CAD software. 3D scanning is essential part of the research, enable to produce fit-to-measure product in a sustainable manner for producing one-of-a-kind product without any production leftovers. The process enable to scan the consumer feet and produce an accurate measurements for perfect fit.

The 'Shifted Craft' collection is a boundary-pushing research project, which was centered around using the Stratasys multi-material PolyJet technology to amalgamate concepts of fashion, to complete high-quality tests with complex shapes, including scaled parts that were as small as a single millimeter in thickness. The combination of crafts, cultures and times create my world - a product that combines parametric design with intuitive handcraft. The project connects expected elements to the unexpected and creates harmony between techniques from different worlds and times.

Video: https://www.youtube.com/watch?v=uiMaJS427yA

Ganit Goldstein

Digital Craft

3D printed textile-fashion garments with hand made techniques

Collection of smart textiles fashion garments including 3D printing and 3D scanning techniques. The technology developments techniques are used to integrate craft techniques with the 3D printing processes to build fit-to-measure garments using exact curves of specific body. The project tackle the mass production fashion garments issues, by using the technology that enable to produce fit to measure garments without waste materials and waste-production.

Concept

The Hybrid of Craft and Technology is essential part of 'Digital Craft' collection. Describing a balanced point of view by examines the connection between technology and tradition through a combination of two creative worlds: handicrafts - traditional weaving, and computer engineering - 3D design and printing. The collection aims to highlight the relationship between the body, form and technology. I chose to create a collection of clothing inspired by my period spent in Tokyo, Japan, and especially, to demonstrate my expertise in the traditional weaving technique IKAT, where unique patterns are created following the dyeing of the threads prior to the weaving process. My work begins with the design and production of digital objects that serve as a three-dimensional object which I then weave handmade threads in a unique manner to each object.

The combination of crafts, cultures and times create my world - a fabric that combines parametric design with intuitive handcraft. 'Digital Craft' collection is a boundary-pushing research project, which was centered around 3D body scan and produced by FDM printer to make customized fashion designs, using flexible materials.

The project connects expected elements to the unexpected and creates harmony between techniques from different worlds and times. The collection, as a whole, presents my interpretation of the balance between the worlds.

Materials: Cotton yarn, 3D printing in thermoplastic materials - PLA, TPU.

ViolinoDigitale I Harris Matzaridis

3D Printed Acoustic Violin

ViolinoDigitale

Replicating real wood acoustic instruments via CT scanning, Additive Manufacturing and respective new materials technology. Blending Technology, Art & Tradition. Replacing Natural Resources (Tonewood) for the creation of acoustic musical instruments.

Summary

The ViolinoDigitale project is examining to what extend new material technologies and Additive Manufacturing can become tools into the hands of artists; While by extension, this project investigates the potential of AM and its new materials to play an important role to the overall Acoustic Space Design and Audio Enhancement sectors (i.e. enhance the acoustic experience inside a car).

ViolinoDigitale's Research Activities

At ViolinoDigitale, mainly, famous and non-famous musical instruments are being "replicated" with the help of CT Scanning and new 3D/4D printing materials and AM methods. But while this project initially focused on providing a "hand on experience to museum visitors via accurate printed replicas of real instruments", currently the project extended, in order to attempt the creation of a new breed of 4D printed musical instruments we like to refer to as "bio-instruments".

"Bio-violins", for example, will "self-adjust"- by dynamically alternating their physical/mechanical properties- not only based to the playing style of the player but also to the composition content. To make this simple, imagine an acoustic instrument designed to have its own programmable "personality"- others tailored to be more "sensitive", they will be more reactive in producing a mellow sound character while a sad song is being played on them. While others more "tough and fierce", they will react more fiercely shaping their sound timbre to become more "loud and noisy" during a musical passage of extreme power (like Beethoven's 9th Symphony).

Few words on the technology involved

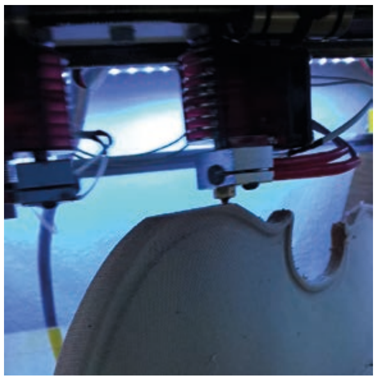
VD material development philosophy is focused on the attempt to "mimic" the internal geometric structure of real wood, and thus resulting polymer objects resembling similar vibrational characteristics. Currently the materials the VD project develops are characterized as being "stimulus responsive", meaning a human behind the printer can change physical properties of the final object during or even after printing, when certain stimulus are being applied to the material. This variability of mechanical properties allows the creation of "more natural sounding" 3D printed objects that can "mimic natural vibrational behavior", that is the vibrational behavior of real natural tonewood (By tonewood we refer to real wood most frequently used for acoustic applications which possesses a nice sounding character).

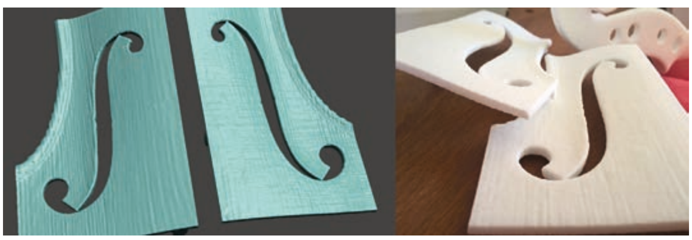
The end result is a natural sounding character of a vibrated plastic object. In addition, by utilizing software simulations and concepts like topology optimization and generative design, we can design violin plates of increased sound projection and of high-quality frequency producing content, for instance by controlling the infill shape and amount of hollow areas inside the interior of the plates. While as industrial 3D printing technology progresses, using base materials with increased stiffness and durability such as PEEK, we will be able to produce eventually a "smart" "bio-violin" while additionally being more durable and lighter than a wooden violin. Adding compounds/additives with "self-healing" properties, those violins will also be able to "self-heal" any occurring cracks resulted from the weathering of time or rigorous playing style (this refers to future evolvements).

Video: www.youtube.com/watch?v=o1xBtruZ-Gc

Conclusion

The ViolinoDigitale project has already produced violin replicas of famous violins, showcasing how current technology inspires even the most traditional of professions (such as violin making). It is inevitable that new material technology and Additive Manufacturing will shape up not only our "materialistic" nature and market related to productivity or space, but also our most "inner world" of artistic endeavors. (VD materials can be used to a variety of applications, including maximizing the sound experience in the interior of cars or using them in a counter-effect framework, i.e. as energy absorbent materials to the interiors of motorbike helmets to absorb impact/fall energy.)





(Dr)Ukulele

Redesigned asymmetric ukulele, produced in a single 3D printed piece

How big can functional 3D printed objects be? How far can we reproduce the function of traditional objects through 3D print? How much can we revisit and re-invent traditional designs through the new technical possibilities of 3D print? The (Dr)Ukulele tackles all of those questions in a single 3D printed object.

On a basic level, the (Dr)Ukulele is a fully functional musical instrument which does not only play comparably to traditionally-made ukuleles but it actually has a distinctive sound and personality of its own.

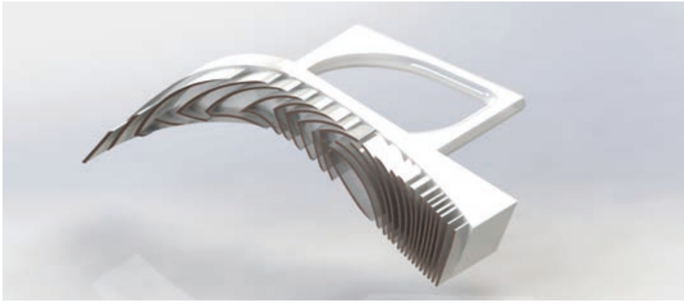
On a technical level, the (Dr)Ukulele is a research object making full use of the large printing capabilities of modern SLS 3D printers. Every part of the (Dr)Ukulele (with the sole exceptions of the pegs and the strings) is a single 3D printed piece, an astonishing feat per se since the different parts of a traditional ukulele have very different functions, ranging from resonance to structure and are therefore made of different materials assembled together. Through careful analysis and design all of these elements have been put together in a functional manner thanks to SLS nylon.

As a design object, the (Dr)Ukulele respects the proportions which are necessary to make an ukulele work acoustically but dismisses the elements which derive from traditional instrument making that are not necessary to its function. The resonance walls blend together in curves and the overall shape is freely asymmetric in a manner that no traditional production method would allow.

The (Dr)Ukulele is insofar 3D Music Instruments' finest attempt to blend into a single object music, playability, sound, design, research and technical prowess through the unique features of 3D-print.

Leonie Fensterle

Eyebrow-Stemp



The personalized eyebrow stamp

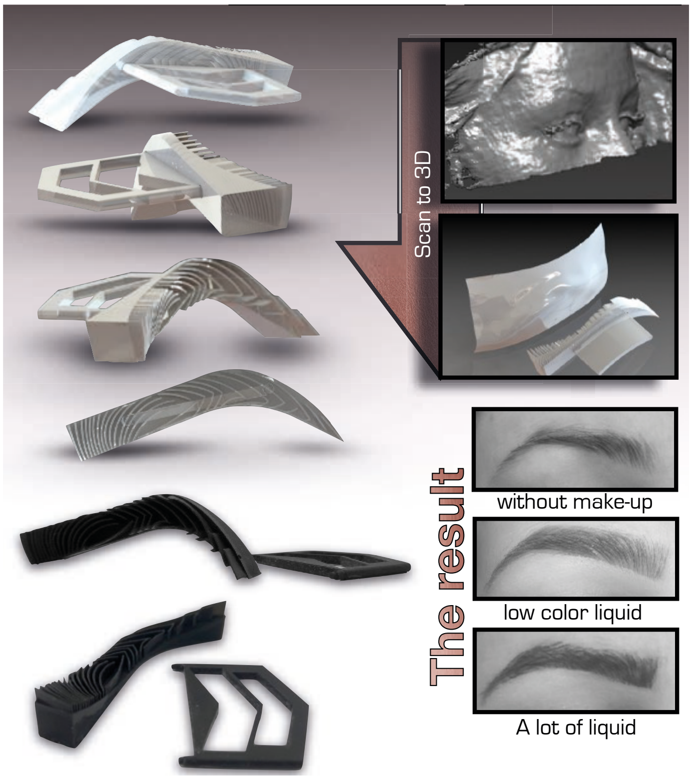
General information:
Everyone is unique. The eyebrows are just as unique. Each eyebrow has a different hair growth, a different shape and different lengths and thickness. Even the left and right eyebrow usually differ.

The problem:
If you want to make up your eyebrows naturally, you have to bring a lot of time and practice. Traditional stamps or templates often fail because they are not adapted to the individual's eyebrows. Moreover, no hair structure is used in traditional products. The result is that you can see clearly that the eyebrow is painted.

The procedure:
To obtain a personalized stamp, the customer must first make a surface scan of his two eyebrows. This can be done with certain apps (such as ScandyPro). (Requirements are an IPhone X or similar smartphones). The next step is a photo of the eyebrows without makeup. This information allows me to identify and develop the right eyebrow shape, the hair structure and the surface of the bone. Both have to be uploaded on my website.

The manufacture:
Once the two stamps are prepared in CAD, they are printed with an accuracy of 0.48mm. The printing process is SLA. Five parts will then be sent to the customer:
- 2 x personalized stamps
- 2 x handles (plastic injection moulding)
- 1 x Eyebrow liquid

The use:
First, the customer will put the stamp and the handle together. Then he paints the eyebrow color on the hair structure and then presses it carefully on the eyebrow. The stamp will be perfectly adapted to the eyebrow curve and draw the hair structure on the skin.



Tamara Trusova

Set #Swirl

Description

Set is included bracelet, ring and earrings. It transmits communication of deep past of the human race, when the first tools originated intellectual progress were a native part of the nature and contemporary age of mathematical computations, built by algorithms, based on the nature principles.

Accessories were made by inspiration of bionic structures, mathematical forms and algorithms created by computational design.

Produced using 3D printing. Material is bronze.

Ganit Goldstein

Between The Layers

3D printed shoe collection with fabric texture

Collection of three pairs of shoes collaborating with Stratasys LTD with extraordinary research working method of printing fabric-like textures with Polyjet technology. The collection combines CAD modeling and texture analyzing with additive manufacturing processes to make new approach of producing 3D printed elements with textured fabric.

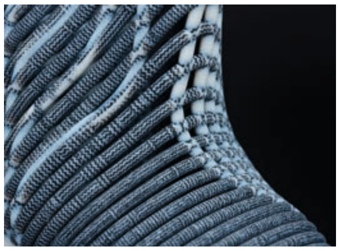
The collection was designed using a combination of 3D scanning and parametric modeling software. The final pieces were 3D printed in partnership with Stratasys Art, Design and Fashion department and R&D team using its multi-material and multi-color J750 3D printer. The shoes printed as one part, with the colors applying inside the printing process, enable to make 3D fabric like shapes with multi-functional and multi-color abilities.

Concept

The Hybrid of Craft and Technology is essential part of ‘Between The Layers’ collection. Describing a balanced point of view by examines the connection between technology and tradition through a combination of two creative worlds: handicrafts - traditional weaving surface, and computer engineering - 3D design and printing. The collection aims to highlight the relationship between the body, form and technology and draws inspiration from a traditional Japanese yarn and fabric dye technique called ‘ikat’. 3D printing with Multi-color ability enables a verity of endless color-matching and freedom of design with CAD software. The ability to match color to shape open a broad freedom platform, creating the basics for 4D printing and self assembly products.

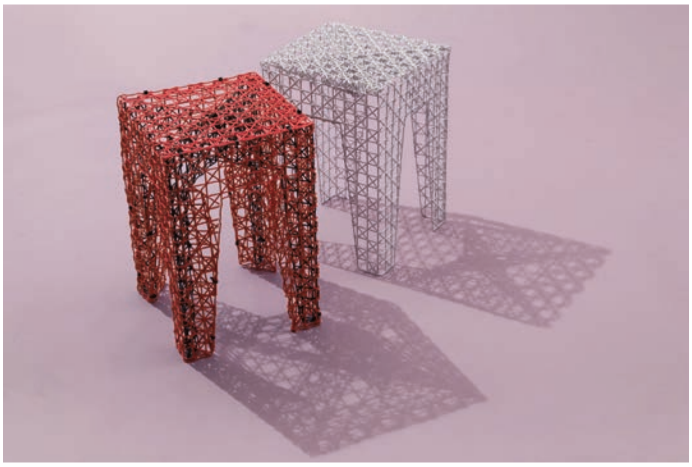
‘Between The Layers’ collection is a boundary-pushing research project, which was centered around using the Stratasys multi-material Polyjet technology to amalgamate concepts of fashion, to complete high-quality tests with complex shapes, including scaled parts that were as small as a single millimeter in thickness.

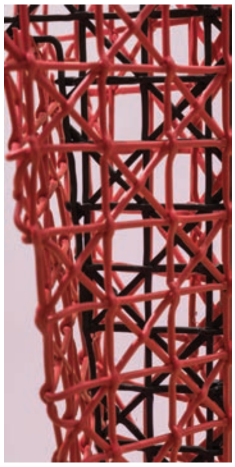
The combination of crafts, cultures and times create my world - a product that combines parametric design with intuitive handcraft vision. The project connects expected elements to the unexpected and creates harmony between techniques from different worlds and times.



Z-zero I Claire Dumont I Etienne Axelos

Zero layer printed stool





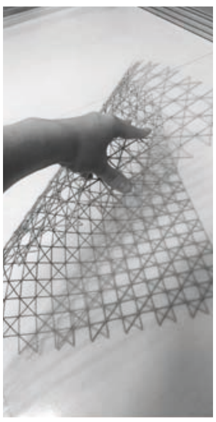
Description

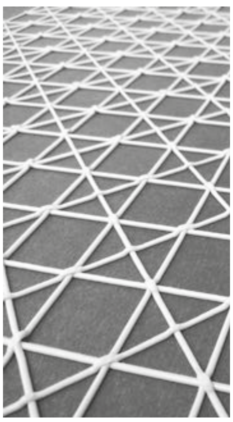
We are Z-zéro, a French design studio which combines design and manufacture thanks to our own 3D printing process. More than just a prototype, we consider the FDM 3D printing a new way to produce, even on an industrial scale. As right now desktop FDM 3D printers do not allow this, we explore new uses of 3D printing that will be able to produce new products by this process. Our exploration of 3D printing possibilities is led by the desire to free ourselves from the requirements of actual FDM 3D printing. It started out with g-code experimentation, and step by step we complexified our tool. First, we create our own software to generate the path and transform it into g-code.

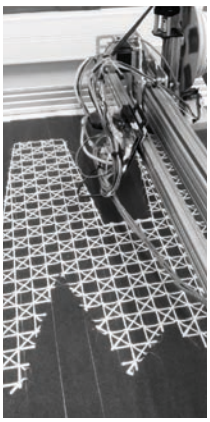
At the same time, we improve our 3D printer to be able to print from small to large scales (1500mm x 1500mm) with different filament diameters up to 2.5mm. In general, the FDM 3D printing generates supports and needs post-treatment. We were looking for strong structures with a minimum of material and that are directly usable. We decide to make a semi-finished material, resistant and quickly customizable. To realise such a structure, we decided to consider it like a mesh that we will use as a raw material for future realisations. This grid is printed flat but all intersections are made by the superposition of all the paths in order to reinforce them. This 3D printed flat grid can be deformed, transformed, melted and shaped at will. The pattern is bio-inspired, from the Euplectella aspergillum, a marin sponge able to build a thin and resistant glass structure.

We have full control of our process and introducing human intervention during the creation of our design provides the right balance between constraints and design freedom. A source of experimentations, we consider the transition between dimensions a playful component of our work.

Among all the processes we use to shape our flat material, the first one we decided to push further is folding. Using this «constraint», we designed a stool to demonstrate our 3D printing process' possibilities. It is printed as one single piece, but like a pattern that we fold thereafter. It is made in PLA and the printing lasts around 3 hours. The pattern is directly ready to fold, no need to cut any supports or sand. We optimized the path to reduce the time of printing and the consumption of material.

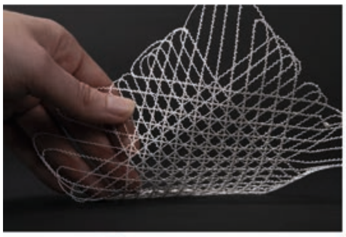


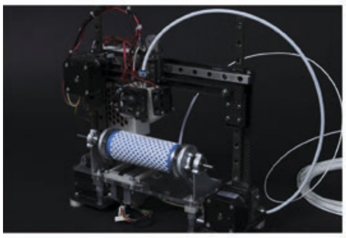


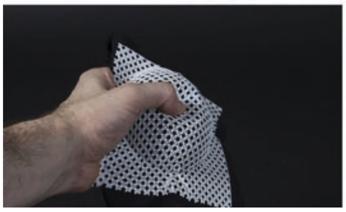


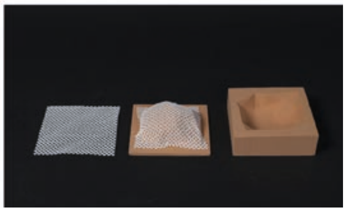
What are the benefits of Z-zéro?

Our innovation gives us a number of competitive advantages. Thanks to the monitoring of our process we can quickly develop implementations for every project and every scale. The flat printing and the path's optimization allows time savings during production. Moreover, by eliminating supports, we avoid wasting time and matter. In addition, this saving in material goes hand in hand with the possibility for recycling PLA even after its shaping. Finally, matter made in the form of a plate facilitates its storage and its shipping until it is shaped, which can be made directly at the place of application. We thus contribute to realise materials with a low ecological footprint. In the future we would like to experiment with thermomoulding, hybridisation with other materials (fabrics, paper…) and also play with filament proprieties. We believe that this new process will allow for plenty experimentations and applications. For instance, we want to develop new materials, in collaboration with research laboratories. As we develop a 3D printing process almost without height, it allows to print materials that are normally not possible to 3D print because they need too much time to dry between two layers (100% bio-sourced material, plaster…).



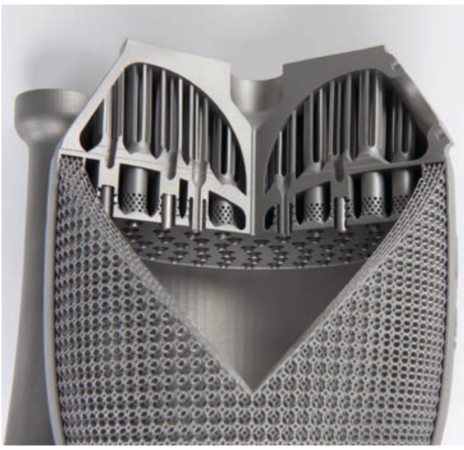


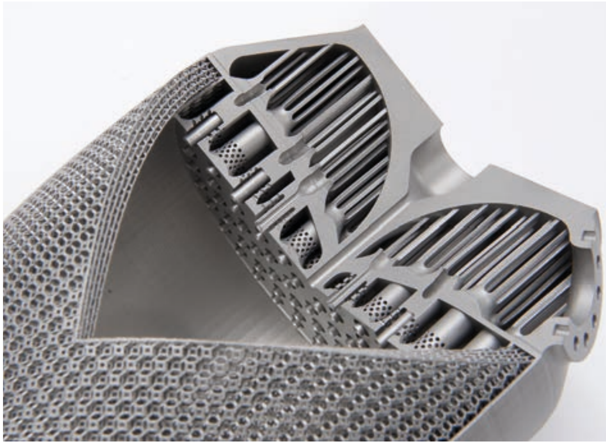




CellCore GmbH I Dr. Paul Schüler I Andreas Krüger

Monolithic Rocket Chamber

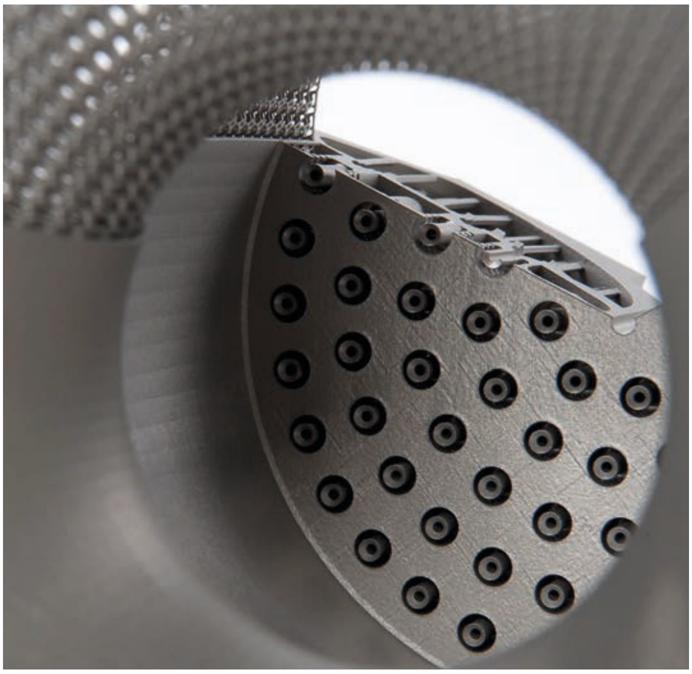




Project description

Monolithic and multi-functional Rocket engine concept
In order to demonstrate the potential and the benefits of metallic, powder bed-based 3D printing for space flight, CellCore GmbH and SLM Solutions Group AG developed a highly complex rocket engine demonstrator that combines a fuel inlet, injection head, thrust chamber and innovative structural cooling concept in an integral design.

The core element of the demonstration piece is the functionally optimized lattice structure integrated into the chamber wall, which in addition to providing the necessary stability, but also offers opportunities for cooling by efficiently conducting heat away from the thrust chamber's internal wall by actively circulating liquid hydrogen. This structural cooling is a significant improvement over conventional approaches such as concentric milled cooling channels. It offers an ideal ratio between stability and the amount of material used, and boasts low flow resistance combined with a large reaction surface. Not only does this make it more efficient, but additional functions are also integrated. The hydrogen that is circulated through the cooling structure is subsequently mixed with the oxygen in the upper section of the engine, channelled into the combustion chamber via the numerous injection heads, and can then be ignited by a spark plug element.

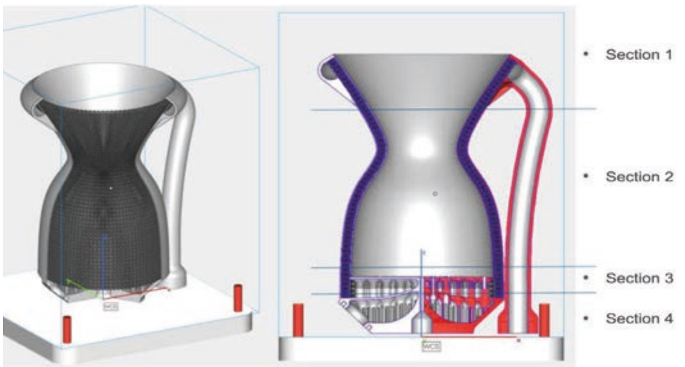


Production-optimised Design

The engine was designed to ensure that production could be implemented with the minimal use of support structures, which would have required labour-intensive finishing work. SLM Solutions supported the project in this regard by assisting the production-related design of the highly complex component in order to prepare it in the best way possible for the Selective Laser Melting process. This included developing specific parameters for the component geometry, including down-skin optimisation and the ideal orientation of the component within the design envelope. In order to avoid errors, critical production areas were also identified and important specification parameters for design modifications were determined using local test-builds. To satisfy the aerospace industry's high material requirements, the engine was manufactured in the nickel superalloy IN718 on the SLM®280 selective laser melting machine.

IN718 is a precipitation hardening material with exceptional tensile, fatigue, creep and breaking strength up to 700°C, and it has already been successfully validated in real, additive application scenarios. This makes IN718 an important alloy for aircraft and gas turbine components as well as numerous other high-temperature applications, such as rocket propulsion engines. When processed conventionally, the hard material is difficult to machine and causes extreme tool wear. Despite its complex structure, post-processing is minimized, thus avoiding high levels of tool wear.

After just a few design iterations, a final design was arrived at that allowed the complex component to be produced within a time frame of just 5 work days using SLM® technology. Compared to the period of around half a year required to manufacture a comparable engine by conventional means, the project therefore indicates the substantial potential savings that additive production and optimised design can offer.



in Kooperation mit SLM SOLUTIONS

Diehl Aviation Laupheim GmbH I Andreas Henneberg

3D-Printed Curtain Comfort Header

Comfort curtain header is a vision of the future

The curtain comfort header as a cabin interior part supports and covers the curtain rails to secure a light and noise restrictive class deviation. Due to individual cabin design, those parts are characterized by high variation and low mechanical requirements. Maximum dimensions are currently 1140 mm x 720 mm x 240 mm. Due to the complexity, curtain comfort headers were originally made from hand layered composites. Diehl Aviation managed to 3D print and fully qualify this complex part with fused deposition modeling using ULTEM 9085 on a Stratasys Fortus 900mc machine. The 3D printed curtain header is the largest series-production part made with additive layer manufacturing for cabin interior applications as of today. First series production parts are delivered and in service with Qatar Airways since Q1 of 2019.

Concept

Diehl Aviation uses fused deposition modeling with ULTEM 9085 on a Stratasys Fortus 900mc machine to manufacture the curtain comfort header. Ultem 9085 is certified by EASA and the FAA. The 3D printed curtain header fulfills all requirements regarding mechanical loads, FST and heat release. The certification for delivering 3D printed curtain headers with EASA Form 1 has been granted. Using tool-less technology, Diehl Aviation enabled short lead-times and a huge degree of freedom for the designer. The integration of functionalities into the printed parts, e.g. wiring canals, brackets, exit sign plates, offers a huge potential for cost savings. Airliner or OEM logos can be printed directly onto the parts to create a more individual design for the customer. Besides the high degree of customization, the 3D printed curtain headers enable the utilization of complex 3D printing for series production of cabin interior parts. As a result, numerous advantages such as reduction of production lead time, functional integration and hence a reduced number of parts can be realized.

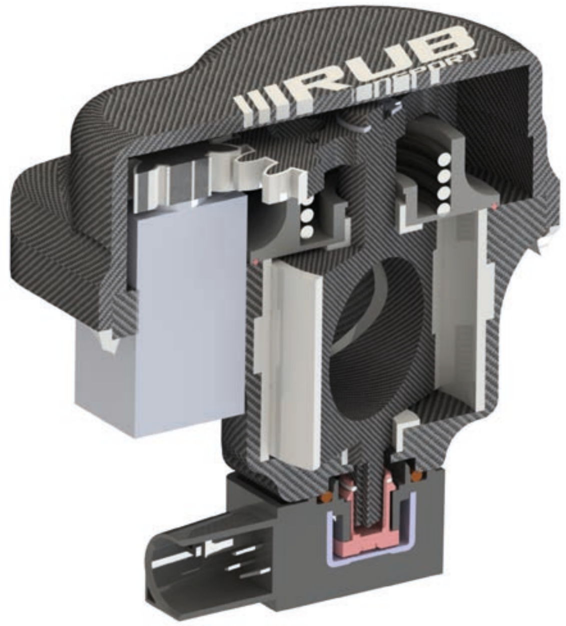
https://www.highlights-diehlaviation.com/en/3d-printing-for-complex-cabin-components/

diehl.com/aviation

In cooperation with AIRBUS and QATAR AIRWAYS

Gero Grabow

Hybrid Throttle Body Concept



Hybrid throttle valve for a formula racing car

Until now, throttle valves produced using additive methods have largely served as concept or geometry models. With the help of multi-material printing and the ideal adaptation of the individual parts of the throttle valve to the prevailing conditions, however, the throttle valve can also be used in the field of rapid manufacturing. The throttle valve's huge potential in comparison to conventional production is highlighted by a comparison of the system's individual aspects with the concept from the previous year (see table 1).

The throttle valve lost 570g of weight in comparison to the preceding year, and therefore weighs only 36% of what the previous year's model does. Costs were reduced by more than €400, and the new throttle valve only costs 30% of what the previous year's model costs. In addition to these benefits, the design of the throttle valve is much freer and a completely new reset system involving torsion springs has been integrated, which was previously not feasible. Transmission into the throttle valve system has also been incorporated, making the system much more compact, which means that a small servo motor is sufficient and less energy is used. The entire throttle valve can also be produced in our workshop. Our throttle valve only weighs 33% as much as the common bought-in throttle valve model of Formula Student (Bosch Motorsport Electronic Throttle Body). Then there is the fact that we can quickly make minor adjustments to future cars without substantial additional costs thanks to additive production. Our throttle valve is ideally adapted to prevailing operating conditions at every point.

In addition to its efficiency, the system's innovation allows it to exceed its other design targets despite the fact that sub-systems such as the housing of the preceding throttle valve were also already produced using additive production. The product also clearly illustrates the potential of incremental progress in the field of additive production. The field of material extrusion, and FLM printing in particular, is one of the oldest additive production technologies. By allowing a change in materials within and not just between layers, a large number of new possibilities have been created. Although this turned out not to be an ideal solution at first, the new possibilities created as a result of combination or post-processing using conventional manufacturing techniques with the assistance of rapid tooling could be used, and turned out to be very useful. Even within minor sub-systems, such as the use of water-soluble support structures, commercial potential has been identified and exploited. Costs can be reduced further still by printing most of the support structure using affordable PLA, and only printing to the connection with the piece using high-quality BVOH. In the field of Rapid Manufacturing in particular, where medium-sized batches are a significant factor, this saving plays an important role and may be crucial to preferring additive production over conventional.

The hybrid production process combining a modified FLM printer and a conventional lathe made it possible to produce a throttle valve entirely as an additive piece that met all previously defined specifications. Thanks to the reduction in weight and the shortened lever arms, the throttle valve has taken a significant step toward the future because, unlike previous concepts, this concept did not need to be subsequently laminated over with carbon in order to be able to withstand the forces exerted on it. The throttle valve has already been produced in its entirety and installed in a Formula Student racing car.

Throttle valve concept comparison 2018/2019

	Concept 2018	Concept 2019
Drive axle arrangement	Colinear	Parallel
Transmission feasible?	No	Yes
Reset concept	Tension spring (outside)	Torsion spring (inside)
Restrictor concept	Cartridge in throttle valve before flange	Cartridge in air box (after flange)
Independent production possible?	No	Yes
Power input (at 6V)	Approx. 10W	Approx. 4W
Power absorbing device?	No	Yes
Weight	Approx. 900g (incl. Laminated carbon)	Approx. 330g
Installation space required	Approx. 1080cm^3	Approx. 603cm^3
Scrutineering quick fasteners	No	Yes
Multi-material parts?	No	Yes
Maximum servo positioning time (60°)	0.08s	0.07s (0.11s on drum)
Maximum adjustable output torque (drum)	105Ncm	219.7Ncm (130Ncm without transmission)
Adhesive joins required	Yes	No
Costs	High costs as a result of third-party manufacturing (complex components), but sponsorship in place in 2018	Low due to in-house production

Table 1: Juxtaposition of throttle valve concepts produced using conventional and additive means

KUPOL R1-0 (Motorcycle helmet)

KUPOL R1-0 Motorcycle helmet

Kupol is a design and development company focused on product innovation, working with key representative partners to expand 3D digital manufacturing innovative products.

They've been investigating protection padding applications with the new BASF ULTRASINT™ 3D TPU01 and saw a great opportunity to apply the benefits of Additive Manufacturing for an innovative new motorcycle helmet concept.

What's unique about this application, is the combination of:
- A hard shell with integrated 3D structures (material: HP 3D High Reusability PA 11)
- the BASF ULTRASINT™ 3D TPU01 material smooth look & feel
- Very strong, thin (down to 0.4mm) walls and structures produced with HP Multi Jet Fusion (MJF)

The PA11 hard shell and the absorption structures are combined to obtain a strong protection against object penetration while being flexible enough to absorb a maximum amount of energy at impact. Working with open structures allows for a highly efficient heat dissipation. The air is gently aspired at the back of the helmet to keep the user head at "room temperature".

Standard helmets have a significant amount of empty space between the protective foam and the user head that is filled with highly compressible fabric padding to fit a large spectrum of head morphology with no benefit to shock absorption and no guarantee over comfort. Kupol's fully customized comfort padding made from TPU exploits this void with crucial protective features such as lower speed impacts and oblique impacts within less than 15mm of thickness; something never achieved before with any other production methods.

This concept also addresses how users put the hat on - with a two-step process for an easier release than conventional products. Separating the main shell from the comfort padding removes the need to apply force to put the helmet on or take it off, protecting the ears in the process. The user simply puts the TPU "cap" on and then slides the main PA11 shell over it, resulting in an enhanced user experience and a final product that offers improved protection.

Beyond comfort and performance benefits - Kupol was able to achieve a compelling production cost for the TPU padding by printing the part in a folded position. The result is impressive: five complete units can be printed in a single build in only 12 hours on an HP Jet Fusion 5200 3D printer.

Kupol were able to improve product performance – yet the production cost of the PA11 shell is comparable to standard production methods, such as carbon fiber composites. Gabriel Boutin, CEO at KUPOL, strongly believes that 3D printing is set to transform the protective equipment industry – "It opens up an infinite playing field to engineer the future of body protection".

For an R&D enterprise like KUPOL, being able to iterate daily on end-user parts is an incredible advantage compared to other technologies. When paired with mechanical simulations and rigorous physical tests, this rapid pace of improvement leads to unimaginable levels of safety.

Designer's name: Gabriel Boutin, KUPOL INC.
Official product name: KUPOL R1-0
Product dimensions: 347mm x 249mm x 251mm