

A Perfect Fit

Fashion's elite are finding creative ways to apply science, technology, engineering and math to haute couture

By Liz Grossman

Fashion designer Julia Körner mashed together her passion for nature, architecture, high-tech and fashion while creating her fall 2015 collection. Her Kelp Jacket, inspired by the seaweed's structure, explores new possibilities in flexible 3-D printing for ready-to-wear couture. ▶

GER GER FOR SCHÖN MAGAZINE



I'll never forget slipping on my mother's 1970s-era mood ring. It was the mid-'80s, and the silver band swung loosely around my index finger.

I would stare at the black stone, waiting for it to morph into a lush forest green or, if I was lucky (or happy, apparently), amber. Sometimes it changed and sometimes it didn't, but the idea of jewelry reading feelings seemed like the future.

A decade later, Hypercolor T-shirts had middle schoolers patting each other on the back to see their handprints transform from neon pink to green. But the heat-sensitive technology of Hypercolor clothing could be ruined with a single hot-water wash. These glimpses of the future of fashion were fun but fleeting. Today, the melding of fashion and technology has morphed into so much more than neon, as everything from haute couture to small- and large-scale shoe companies are collaborating with scientists, computational designers, biologists, architects and even the consumer directly, ever-challenging the ideas of how we wear, buy and even discard of, designs. The results are custom creations that blur the lines between fashion and art; introduce textures, textiles, fit and forms that didn't exist before; and combine craft-making with technology — from 3-D printing to laser sintering.

WAY OUTSIDE THE BOX

There's something about the work of award-winning haute couture Dutch designer Iris van Herpen that organically blends science and nature. Her plastic-based 3-D designs resemble flowing water, clusters of twisted branches, water splashes frozen in time or the glass-like beauty of bubble wrap-esque circles — all fitting beautifully to the human form. The timeless silhouettes of her clothing and shoes flaunt twists, curves and cutouts that look like futuristic glimpses into the fashionista closets of the next millennium.

Van Herpen, who studied under Alexander McQueen and started her own label in 2007, achieves many of her looks through 3-D printing, laser sintering and other digital technology through collaborations with architects, artists (from Beyoncé to Lady Gaga), scientists and designers. She continues to create boundary-pushing pieces, often written about and on display at exhibits like the upcoming *Manus x Machina: Fashion in an Age of Technology*, The Costume Institute's spring 2016 exhibition at The Met.

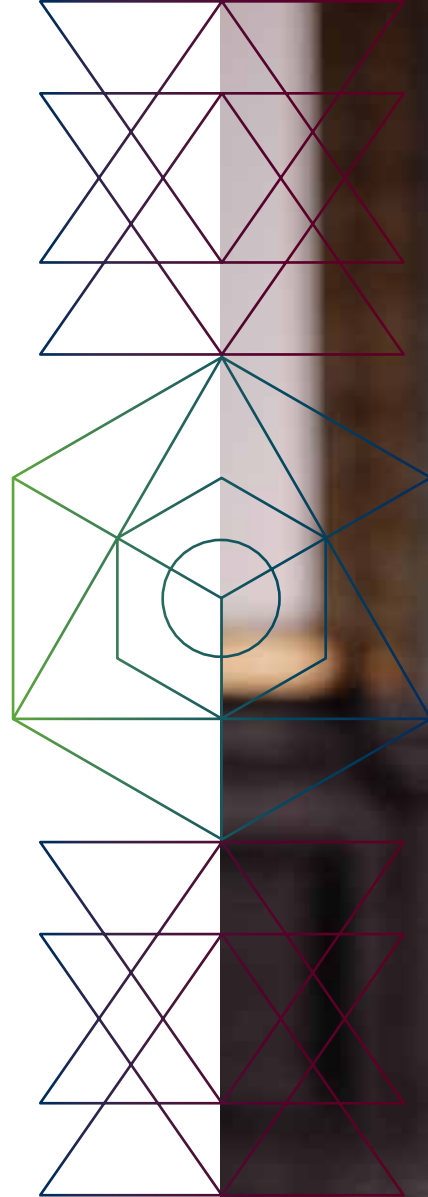
Among many of Van Herpen's collaborations, her work with Austrian architect, designer and UCLA lecturer Julia Körner has resulted in some of her most stunning work to date. Their first collaboration was revealed at Paris Haute Couture Week in 2012. It was a breathtaking dress called Hybrid Holism that looks intricately carved out of petrified honey. To make it, they used stereolithography, which Körner describes as one of the biggest 3-D prints you can make. The piece was printed in two parts, front and back, and took a week to print. "It's a process where there's liquid resin struck by a laser, which builds up the geometry layer by layer," explained Körner. For another look, they experimented with flexible plastic and created the intricate black lace-like Voltage dress, shown at Paris Fashion Week in 2013.

"In each of our collaborations, we used different technologies to research the material and its behavior within the garment," said Körner, who enlisted Belgian company Materialise for the printing and laser sintering, "which is different from stereolithography," she said. "It's when you have a box of powder and a laser binds it in layers, and you end up having a powder-based structure." ▶

DID YOU KNOW? / The first major exhibition of Iris van Herpen's work, titled *Iris van Herpen: Transforming Fashion*, opened at the High Museum of Art in Atlanta in 2015 and featured 45 of her most groundbreaking outfits.

DID YOU KNOW? / Australian designer Donna Sgro created a dress made from Morphotex, a fabric that imitates the microscopic structure of the Morpho butterfly's wing.

DID YOU KNOW? / Dutch fashion designer Marieka Ratsma and American architect Kostika Spaho created a 3-D-printed shoe inspired by a bird's skull.

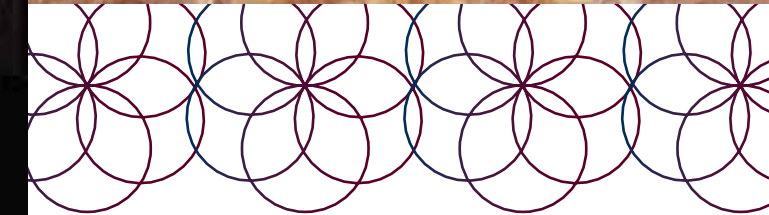


BOY KORTEKAAS

MEETING OF MIGHTY MINDS

Dutch fashion designer Iris van Herpen and Austrian architect and designer Julia Körner have conspired and experimented with stereolithography, laser sintering, flexible plastics, geometry and biomimicry to "print" jaw-dropping pieces for the fashion world's most prestigious runways, including the Hybrid Holism (below) and Voltage (at left) dresses.

SOPHIE VAN DER PERRE



HIGH-TECH HEAD TO TOE

Wearable technology as an industry is really still in its infancy. Even so, it's not too difficult to imagine yourself dressed in tech top to bottom.



THE HANDBAG

The Mirror Handbag has laser-etched acrylic mirror sides that let light from white LEDs shine through, creating amazing animations. cutecircuit.com

THE DRESS

Constructed of holographic leather and sound-reactive animated electroluminescent panels, the Thunderstorm Dress becomes illuminated with lightning bolts as volume increases. rainbowwinters.com

THE SHOE

E-ink technology and an electronic paper display give the Volvorii high-heeled pump the ability to change hues from black to white and back again. indiegogo.com/projects/volvorii-timeless

Their third collaboration resulted in another 3-D-printed dress, revealed as the jaw-dropping finale in Van Herpen's Biopiracy collection at the Paris Ready-to-Wear Fashion Show in 2014. The dress was printed using laser sintering and was coated after the printing process with silicon to add a glossy sheen to what looks like an explosion of feathers that flow with the body. Van Herpen, whose designs sometimes start with a sketch that is turned into a 3-D-printing file, often finishes her partially printed pieces by hand, so that "the randomness and irregularities that are created by hand dominate the computational systems, which is more interesting," she explained in a 2014 interview with *The Business of Fashion* magazine. "When the computer defines the design language, it can be too perfect or too anonymous."

NATURE AS INSPIRATION

While costs are high and materials are still somewhat limited for high-end 3-D-printed clothing (you can't print cotton or nylon yet), Van Herpen and Körner have been successful in manipulating plastic-based materials to move organically with the body. This is seen most impressively in Körner's own ready-to-wear line of 3-D-printed

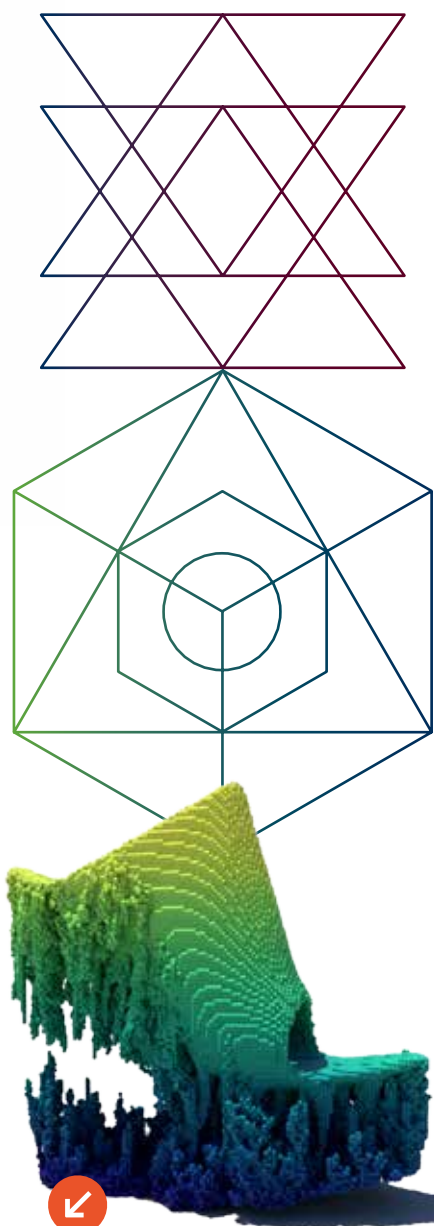
clothing and accessories based on scans of things found in nature, from kelp to mushrooms. "I developed an algorithm computationally to a 3-D structure to understand its geometry and developed a structure which simulates the intricacy of these patterns," explained Körner of the pieces she had printed at U.S.-based Stratasy. "The Kelp Jacket can be harder where it needs to be and more structured and softer where it needs movement," she said. Although made of plastic, the elegant shape and folds of the gradient white-to-black jacket look hand-sewn and made-to-measure on the body.

"With any other garment-making technique, you cannot really do anything like this," said Körner. "You would need to use casting techniques or similar processes with a thread and needle. You couldn't generate these lace-like structures. So what's exciting about designing with the computer is you can come up with totally new 3-D structures and a new aesthetic to garment design," she said.

MIXING OLD WITH NEW

Another designer who's been obsessed with 3-D printers since he worked with them in architecture school is Francis Bitonti, whose eponymous New York City design studio is known for collaborating on stunning pieces such as the entirely 3-D-printed, 17-piece dress created with designer Michael Schmidt and Shapeways for burlesque star and model Dita Von Teese in 2013. His company collaborates with startups, fashion designers, accessory makers and Fortune 500s to print one-off and small-production runs of everything from belts to furniture. Bitonti heads up the computational design aspect, often collaborating with material scientists, engineers, computer programmers and fashion designers to bring the often one-of-a-kind pieces to life. ▶

ALL PHOTOS ON THIS PAGE COURTESY OF FRANCIS BITONTI STUDIO



DID YOU KNOW? / Francis Bitonti's Molecule Shoes are completely manufactured in a digital environment, one pixel at a time, using Adobe digital design software and Stratasy's 3-D printing technology.

glossary

Biomimicry an approach to innovation that seeks sustainable solutions to human challenges by emulating nature's time-tested patterns

Stereolithography a technique for creating three-dimensional objects by using a controlled moving laser beam to cure a liquid polymer layer by layer, creating a solid structure

Laser Sintering involves the use of a laser to fuse particles of plastic, metal, or ceramic into a mass that has a desired three-dimensional shape.

need rewrites from Jennifer

THE MANY BEHIND THE ONE-OFFS

New York-based designer Francis Bitonti likes to collaborate with a mix of startups, designers, Fortune 500s, computer programmers and material scientists to print his single- and small-production fashion creations, such as the 17-piece dress for burlesque star Dita Von Teese (right), the Brambles jewelry collection (opposite page, top) and the Bristle Dress (opposite page, lower left).



DID YOU KNOW? / In 2014, celebrated clothing designer Tommy Hilfiger launched a line of clothing with solar cells to charge devices.

READ *Fashionable Technology: The Intersection of Design, Fashion, Science and Technology* by Sabine Seymour ▶

WATCH The segment on *The Henry Ford's Innovation Nation* about Aamir Patel's stain-resistant nano silic shirt thehenryford.org/innovationnation/episode7.asp ▶

ALBERT SANCHEZ PHOTOGRAPHY

A PERFECT FIT



FRANCIS BITONTI STUDIO

The Tennessee-based “digital cobbler” Feetz makes 3-D-printed shoes fitted to photos taken of a customer’s feet. ▲

READ Page 14 in this issue of *The Henry Ford Magazine*, and learn about the Electroloom, one of the latest startups to mash up 3-D printing and wearable fashion. ▶

READ *Make: Wearable Electronics: Design, prototype, and wear your own interactive garments* by Kate Hartman ▶

“I’m trying to help brands make projects we can build at scale,” Bitonti said. “We create these one-off pieces to try out ideas, when it’s too early to get into large-scale production.” By working on collaborations with small designers, Bitonti says they’re able to drop the barrier of entry for them. “Up-front costs aren’t there, unit costs end up being higher — it’s great for young designers at this point in time,” he said.

One of Bitonti’s collaborations is with Tennessee-based Feetz, a “digital cobbler” that makes 3-D-printed shoes fitted to photos taken of the customer’s feet. “It’s about mixing old and new,” said founder Lucy Beard. “Shoes have been around for hundreds of years, but you used to go to a cobbler who would wrap your foot for sizing. Then, 200 years ago, some British noble created standard shoe sizes based on an ear of corn, and that was the start of the sizing system.” Beard’s goal with Feetz is to make every shoe personal to the customer, “but you don’t make the new shoe until you want it or need it. It’s more sustainable. That’s the digital side — there’s no waste.”

But even if a sustainable 3-D-printed shoe offers a perfect fit, it still needs good, wearable design, and that’s where Bitonti came in. “We’d gone over 30 different designs, including weird and wonderful high couture wedge shoes, which were cool, but we wanted them to feel like real shoes,” said Beard. She met Bitonti at an event in New York City and recruited him as a designer and official adviser to Feetz.

“I like people like Francis,” said Beard. “He’s an architect, but he thinks about weird, quirky ways and

unconventional methods. He’s willing to ask, ‘Why couldn’t it be like this?’ Now we can define and break through barriers, while the new school catches up and starts to learn what the new digital rules are.”

It was a happy printing accident that created Feetz’s latest collection with Bitonti, a 3-D-printed flat that’s plastic-based but resembles, knitted yarn.

“The printer messed up, and Francis looked at it and said, ‘It’s kind of woven, like knitting,’ but instead of yarn, it’s made with 3-D filament.” Beard liked the natural look of the material that bends with the foot, and the next collection was born. After printing, the shoes are given a soft liner and carbon fiber sole, and sent to the customer within a week.

“It’s not the material, but how you use it,” said Beard. “It’s like an egg. It’s this thing in a shell, and if I crack it, I can drink it raw, or cook it and make it hard, or whip it into a meringue. It’s the same fundamental material, but it’s about what you do with it and how you transform the properties.”

Körner agrees that no matter what technology or material is used to make a product, the designer’s vision and craftsmanship remain at the heart of its creation.

“All these collaborations are sort of handcrafted, but the difference is that they’re digitally crafted; so it’s not a software that generates these pieces by themselves, it’s still a designer sitting there for weeks designing and handcrafting the piece within the computer,” said Körner. “I find it interesting if a very old tradition is combined with a very futuristic technology.”

And that type of fashion is, no doubt, the future. ●

CLOTHES MADE IN YOUR CLOSET

While 3-D printing is nothing new (the technology has existed since the mid-’80s and has been used to create everything from dental implants to prosthetic limbs), there’s no question that as 3-D printers come down in price and accessibility, custom-printed clothing, jewelry and accessories will become as ubiquitous as online shopping sprees.

“One day, it’s going to be this thing in your closet where you press a button and you’ll go to sleep, and your new shoes will be there in the morning,” said Lucy Beard of Feetz, a digital cobbler of sorts. “It’s fast-fashion driven by the consumer.”

While the Jetsons-esque appeal of overnight insta-shoes is still a way off, small startups like Chicago-based MNGRM are one of the ever-growing accessories companies around the country that allow customers to design and order their own 3-D-printed jewelry. Architect-cum-computational designer Max Davis learned to build the modeling technology while in school, and now uses it (with the help of a 3-D printer on the East Coast) to create 14K gold, polished brass, silver and platinum necklaces based on any combination of letters or initials.

On the apparel side, Dutch designer Martijn van Strien recently launched The Post-Couture Collective, which allows the consumer to get made-to-measure, custom-fit clothing created from 3-D-knitted material that can be downloaded, printed, assembled and even recycled after it’s worn.

“I think this technology tells a story. It shows consumers exactly what it takes to make a garment, which should in turn help them understand a \$5 T-shirt can’t be made in an ethical way,” said Van Strien. “I don’t think we’ll all be wearing these exact garments in 20 years, but I hope it’s a step in the development of a more sustainable and fair industry.”

Bitonti foresees more 3-D printing happening in homes but agrees it’s still in its infancy. “I could see people starting to have lots of micro-factories for small-batch local productions. The challenge is how we’ll be able to do lots of small-batch production at mass scale.” He sees enthusiasts, hobbyists and gamers catching on first, and for “those willing to put that effort in, there’s an emotional connection with what you’re doing, a desire to be a part of that process.”



MELISSA FERRARA



MARTIJN VAN STRIEN

HOME COUTURE

The Post-Couture Collective allows consumers to create custom-fit clothing from 3-D-knitted material that can be downloaded, printed, assembled and even recycled after it’s worn. Through MNGRM.com (inset), customers enjoy the same sense of homebound creativity, designing and ordering their own 3-D-printed jewelry online.