
# CONNECTED

A MAGAZINE BY LEMO

SUMMER 2015 N° 4

The Amazing World of 3D-Printing

LEMO Goes Beyond Connectors

Okazaki Raising Technology to Extreme Levels




LEMO has been a synonym for high-end connectors for almost 70 years. Now we will be able to further extend our image. Since the acquisition of Northwire, we have been – for the first time in our history – able to provide our customers with complete interconnection solutions, entirely “Made by LEMO”.

It is not about pure marketing, but a genuinely new step forward in our product and market development. It means a real impact for both our customers and our organization (see “Beyond Connectors” on page 24).

For LEMO this is a natural extension. For several decades, we have been manufacturing a very wide range of cable assemblies with cables from rigorously selected suppliers from around the world.

By manufacturing our own cables, we can now go one step further in controlling the quality, reliability and innovation that are the foundations of our reputation. It also brings us new know-how, with even greater opportunities to provide our customers with innovative custom interconnection solutions.

These solutions will enable you, our customers and partners, to push back the limits of technology even further.

LEMO is entering a new era and we look forward to sharing it with you.

Alexandre Pesci
Corporate CEO
LEMO

“Improving patient treatment, 3D printing will soon have a concrete impact on people's health and quality of life”

SÉBASTIEN MARTINERIE
3D PRINTING SPECIALIST,
LAUSANNE UNIVERSITY
HOSPITAL, SWITZERLAND



IN THIS MAGAZINE






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# TECH-BITS FROM AROUND THE WORLD

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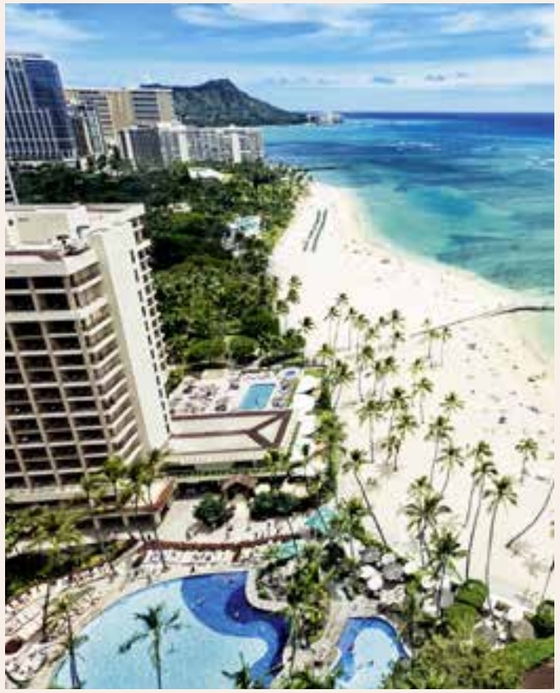

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**1. GOOGLE CARS, WATCH OUT: TRUCKS ARE COMING!**

Early May, Daimler Trucks North America presented the Freightliner Inspiration, a prototype for the first licensed autonomous commercial truck to operate on an open public highway in the United States. A driver will in fact need to remain behind the steering wheel. However, if it is daytime, fine weather and the highway well maintained, the driver could read a magazine, watch a film or play Real Racing on an iPad. The Highway Pilot (a set of camera and radar systems with lane stability, collision avoidance, speed control, braking, steering and other technologies) will take care of the rest.

**2. HAWAII SAYS "ALOHA!" TO CLEAN ENERGY**

Early June this year, the Governor of the State of Hawaii, David Ige, signed into law a bill dubbed "the most aggressive clean energy goal in the US". The archipelago is committing to produce – by end of 2045 – all its electricity from renewable sources. Today, about 80% is still derived from "dirty" sources, mainly oil power stations. Wholly imported, this oil costs Hawaii $3-5 billion every year, therefore driving up the price of electricity (up to three times higher than the average cost in the US). With an initial target set in 2008 (40% renewable energies by 2030), Hawaii has become the top American state for solar energy use.

**3. MAGNETIC TAPE STRIKES BACK**

We may have thought that magnetic tape had been exterminated by CDs, DVDs and other hard disks, but it could be experiencing a new revival. IBM (US) and Fujifilm (Japan) have developed upon this technology, managing to pack 220TB (around 220 million books) onto a tape cartridge. That's an 88-fold improvement over the industry-standard LTO6 cartridge. What is more, tape has encryption built in, lasts 30 years and does not consume power. All strengths, as asserted by the two giants, making it a strong backup option for cloud application archives.

**4. CONNECTORS REACH A NEW MILESTONE**

The connector industry surpassed the 50 billion dollar mark for the first time in 2014. A finding reported by Bishop & Associates who have been tracking the industry for the last 35 years. Sales have reached $52.9 billion, six times more than in 1980. This is a compound annual growth rate of 5.3%. For Bishop & Associates, the 50 billion dollar mark would have been exceeded earlier if it had not been for the recession started in 2008 (leading to a 22% contraction in sales that year).

**5. A ROOM WITH A VIEW ON THE UNIVERSE**

A team of 19 researchers from the USA, Germany and Switzerland have designed a very special $4m^3$ room. Within it, there is no magnetic field. Such a room exists nowhere else, unless you count intergalactic space. To achieve this, they built a "Russian doll" structure, a succession of magnetic shields, mainly using Magnifer, a nickel-iron alloy with unique properties (magnetic fields arriving from outside the room are redirected into the metal). The changes in external magnetic fields are reduced by a factor of 7 million. That's enough to check – even better than with a LHC – certain points of the Standard Model of Particle Physics. Other experiments, such as measuring the brain's magnetic signals, could also benefit.



# SHARPER IMAGES

By Alexis Malalan

**LEMO has just launched a new range of SMPTE & ARIB fibre optic cables for broadcast applications. The new products should meet the most stringent requirements of broadcast professionals in terms of ruggedness and reliability.**

The Soccer World Cup, Grand Slam tournaments, the Olympic Games: high-profile international sports events have become a MUST for television channels around the world. Any broadcast interruption before an audience of hundreds of millions of viewers caused by connection problems, is simply out of the question. Thanks to LEMO and its subsidiary Northwire, broadcast professionals can now count on a new hybrid fibre optic solution which ensures optimum signal distribution, from the camera to the OB van parked outside. The first special feature of the cable is its material. Fibre optics support the highest resolutions, such as HD or 4K. The specially formulated PVC jacket is particularly resistant to abrasion, cuts and impact.

Another highlight: the newly designed cable meets the strict standards of the American Society of Motion Picture & Television Engineers (SMPTE). This international association, a world reference in the field of film and television, has developed their own quality standards. In order to meet the standards, the new cable had to pass a large number of tests, which were carried out by an independent test laboratory in the USA and the LEMO Group Fibre Optic R&D centre, LEMO FOUR. Similarly, the ARIB version meets the demanding requirements of the Japanese Association of Radio Industries and Businesses. The tests analysed the maximum curvature, the cable's resistance to temperature and humidity as well as its mechanical resistance in specific conditions, such as a vehicle rolling over it.

All in all, the key asset of the new SMPTE & ARIB cables is their quality. They meet all the challenges of outdoor broadcast and, at the same time, they are specially adapted for easy operator handling.

Most important, the new cable is the only one among its competitors to have obtained the UL 758 approval. Delivered by the US consumer product safety agency Underwriters Laboratories, the approval guarantees that the cable does not ignite and thus prevents any risk of fire spreading. The cable doesn't burn and it is self-extinguishing. If one end catches fire, there is no risk that the fire will spread to the other end.

LEMO performs connector and cable assembly in many countries (see article on page 24). Fibre optic cable assembly requires special training, which is provided by LEMO FOUR (Fibre Optic Unit of Research) in England. Maintenance is critical, as the slightest contamination may interfere with signal quality. Therefore, the fibre ends need to be inspected frequently, depending on usage, and cleaned if necessary. Specific cleaning tools have been developed and are available from any LEMO subsidiary.

Two versions can be discovered at IBC 2015: The new cable is available in two versions: SMPTE (for the US market) and ARIB (for the Japanese market). For the time being, they are predominantly used for outside broadcast or in studios. A low smoke zero halogen installation grade is also being developed for permanent studio installation.

▼ LEMO's new SMPTE & ARIB cables.

# NEED SOMETHING? JUST HIT CONTROL + P

By Nicolas Huber

## From body organs to houses on other planets, from meals to shirts, tea mugs to bridges: 3D printing is already starting to revolutionise the way things are made and their accessibility. So much so, that the presence of this technology has already started raising eyebrows. For good reasons and not so good ones.

The Koran, just like the Bible, Sumerian, Greek, Chinese, Egyptian and Inca mythology, as well as many Amerindian myths tell about the creation of man from clay, dust or mud.

Watching a 3D printer in action reminds us without doubt of this fundamental parable. From raw material, little by little, something new appears and comes to existence.

Born in the eighties, the process is more self-explanatory under its other name: additive manufacturing. A 3D model is created by CAD, virtually decomposed into fine layers and built up by a machine layer upon layer. A variety of techniques are used (stereolithography, fused deposition modelling, selective laser melting…), but the principle is the same.

At first limited to rapid prototyping, 3D printing has been developing very fast. It is now possible to print in plastic and polymers, but also in metal (titanium, gold, silver, bronze and steel…), wax and sand. Even using food components and biological materials.

The precision of the printers and the quality of finishing have improved so much that it is possible to print finished parts for professional applications (audio headsets, glasses, jewellery) as well as for the most demanding applications, such as the automobile and aerospace industries.

There's no limit to the size either: additive manufacturing can produce furniture and decoration. In 2017, the MX3D robot will "print" – on its own, in mid-air – a steel bridge over a canal in Amsterdam. It is also possible to print houses.

These past few years, the same tectonic shift has been taking place in 3D printing as happened in the world of electronics in the eighties: it's becoming personal.

"Office" printers are proposed by Stratasys (MakerBot) and 3D Systems (CubeX), two leaders in professional solutions. Less and less expensive, becoming user-friendly, they have started to become accessible to the general public.

Individuals can also use printing services offered by major retailers like Auchan in France or Amazon and Staples in USA. They are also capable of printing the required objects through "factories in the cloud" like Sculpteo (see our interview with its founder on page 20) or Shapeways.





Durotaxis, a dual-position rocking chair, designed by Synthesis Design + Architecture, manufactured by Stratasys.

© IMSTEPF Films

## 8.6 BILLION BY 2020

The global market for additive manufacturing has been also gaining a new dimension: in mid-2014, Research and Markets estimated it at 2.3 billion and forecast a growth of up to 8.6 billion by 2020. According to a study conducted by Siemens, 3D printing would be 50% cheaper and 400 times faster by then.

These numbers prefigure the ultimate future of this technology. A future that will be part of our day-to-day life. Companies will produce complex parts without the need for suppliers. Designers and inventors will produce their own creations without having to convince manufacturers first. There will be self-service 3D printers in supermarkets. Families will print everyday objects or even their meals.

A groundswell? Economist and futurist Jeremy Rifkin believes so. He thinks that 3D printing will be one of the pillars of a new industrial revolution. The USA believe in it as well, seeing it as an opportunity to create jobs in sectors relocated to Asia. Barak Obama promoted 3D printing during his 2013 State of the Union address. In Europe, governments support many Fab Labs, these collective factories using 3D printing to a great extent.

Like every revolution, 3D printing also has its dark side.

The highly publicised 3D printed gun by a young Texan in 2013 and its files posted on the internet has given a first glimpse of a potentially anarchic future.

"Classic" industry has adopted 3D printing while feeling concerned about having the same experience as with MP3 and the music industry – a gravedigger of copyrights. The illegal production of objects (starting with figurines from films, TV series or video games) has been growing. Cease and desist letters have become common practice.

With 3D printing, the future hits the present. The medical industry illustrates this shock particularly well (see pages 18-19). In Europe, in Asia, as in the USA, we have surpassed the problems of custom prostheses or implants. Living tissue printing is being developed. At the end of 2014, Organovo marketed the first human tissues, produced on an in-house 3D printer.

How about the next step? It is on its way: producing functional organs on request!

Print a heart, implant it in a chest, see it beat. 3D printing will recall more than ever Divine creation.

# FASCINATING TODAY, REVOLUTIONARY TOMORROW!

**At the Lausanne University Hospital (CHUV), as in many public hospitals in the world, 3D printing is still in the observation phase. But the current results are spectacular and the future outlook almost dizzying. Interview with Sébastien Martinerie, 3D printing specialist at the CHUV in Lausanne, Switzerland.**



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Sébastien Martinerie, 3D printing specialist, Lausanne University Hospital, Switzerland

For how long has 3D printing been used in the medical field?

**Sébastien Martinerie:** For about ten years now... To begin with, it was used to create custom ear implants, dentures, etc. New applications, such as printing human tissue, are much more recent. This constant progress means that 3D printing is still an emerging technology in the medical field.

Can we already say that it is revolutionising medicine?

In my opinion, not yet. We were already producing prosthetics and tissue before 3D printing. It has 'just' changed the way we do so, increasing precision and reducing costs and lead times. For me, 3D printing therefore seems less revolutionary than things like scanners or MRI which have brought medicine into a new era. Of course, when we are able to print a functioning organ, that will be revolutionary.

Not a week goes by without the media reporting a spectacular case of 3D printing in the medical world. Is the number of applications increasing?

Just five years ago, few people knew what 3D printing was, both in the medical world and elsewhere. Then it started to get popular and gain more media coverage. This had a snowball effect and many ideas and developments arose, including in the medical field. Several applications seem futuristic, making them of interest to the media. Things like printing 'springs' which prevent respiratory channels that are too flexible from closing, titanium prosthetics to rebuild a patient's smashed skull or an exoskeleton to help a young girl suffering from a muscle disorder to be able to move again...

What are the advantages of 3D printing?

With 3D printing you can custom produce something highly complex for about the same cost as mass producing something simple! This is particularly valuable in the medical field, where each case – patient and trauma – is obviously unique and the shapes are highly complex.

One of the key applications of 3D printing is its ability to help specialists better visualise things...

We print in 3D the area to be operated (organ, bone or even a tumour) and obtain a perfectly identical model of the original...

… a model far more telling than traditional 2D images or 3D modelling displayed on a screen?
Absolutely! Surgeons can hold, manipulate and observe the printout as if they had the original in their hands. I can tell you about a recent example. It was only once a child's heart had been printed in 3D that the American team realised the planned operation was not possible. They were therefore able to develop another solution.

Do surgeons use these models to prepare for their operations?
Yes, they can visualise the area to operate, demarcate the area to be removed, check access pathways and the movements that will or will not be possible. They can also prepare, test and fully complete a prosthetic to be fitted. These stages are usually undertaken on the patient, during the operation. With the 3D models we print at CHUV, we have been able to reduce the duration of some maxillofacial surgeries by 50%. The prosthetic is ready before entering the operating block; the surgery is just for fitting it.

What about implant printing?
Implants are printed using biocompatible materials, mainly titanium. We print hips, portions of jaw and skull and more… We can use a scan of the patient's intact bone - the opposite hip or other side of the jaw - and invert the image before printing. The result is an ultra-accurate implant, perfectly suited to the patient's body. This makes the implants easier to fit than standard models. They also generate less wear in the recipient's body and promote osseointegration, therefore making it easier to heal and function again.

*"CREATE PERFECTLY ADAPTED IMPLANTS"*

The Lausanne University Hospital chose a 3D Systems ProJet 3510 SD to explore the technology. ▼





Even more recent, bioprinting is different. The print material is organic and we directly print living tissue…
With 3D printing, we can print tissue whose geometry and structure are more complex than tissue grown in petri dishes. The tissue is therefore much closer to reality and behaves more like real tissue. This opens up vast opportunities in pharmaceutical research, for example. Substance tests are much more effective, we can eliminate much earlier those not appropriate, and use far less animal testing. The time taken to develop a drug can be drastically reduced; the financial impact is therefore huge. Significant indeed… Late April, Mercks concluded a research partnership for several years with Organovo, an American company which produces human tissue using 3D printing.

Some even dream of printing organs, helping to save the lives of thousands of people currently dependent on organ donation…
Talking of this today is tantamount to placing wild - and still unrealistic - hopes in the minds of those waiting for an organ. It is still impossible to print an organ, for the same reason that it is still impossible to print a smartphone: too many interlinked components and too many different materials… The most optimistic of people forecast organ printing possible ten years from now, but I am less optimistic. Once we do manage it, we'll still need to conduct tests and handle the ethical issues…

… They are just prosthetics. We're not creating life and no donor is implied, so what are the ethical issues?
Mainly relating to the separation between repairing a damaged body and improving a body…

… We could print 'improved' muscles for top athletes or titanium bones for super-soldiers…
Unfortunately, like with any technological progress, we cannot ignore what could happen to it in the wrong hands. 3D printing is not excluded. Look at the case of the young man who printed himself a firearm and then put the 3D file on the Internet for others to access.

When will 3D printing really enter daily practice at hospitals?
We are all convinced that 3D printing has a very bright future in the medical field. But the clinical, and especially financial benefits, have not yet been studied enough. Once these benefits have been measured, 3D printing will enter hospital routine. We're not there yet, but the day is coming!

3D printing helps specialists ▲ to prepare for surgery.

"PRINTED MODELS ACHIEVE AN ACCURACY OF A FEW MICRONS"

# PRINTING AN EXACT COPY OF THE PATIENT

On the table is the horizontal section of a skull. White. Matt. With all its external curves and lines, all the complex structures of its inner volumes.

Despite appearances, this is not a real skull. Just a reproduction – accurate to within a few microns – of the skull of a young patient at CHUV (Lausanne University Hospital, Switzerland). It was created on a ProJet 3510 SD, a mid-range, highly accurate printer model designed by 3D Systems, one of the leaders in 3D printing solutions.

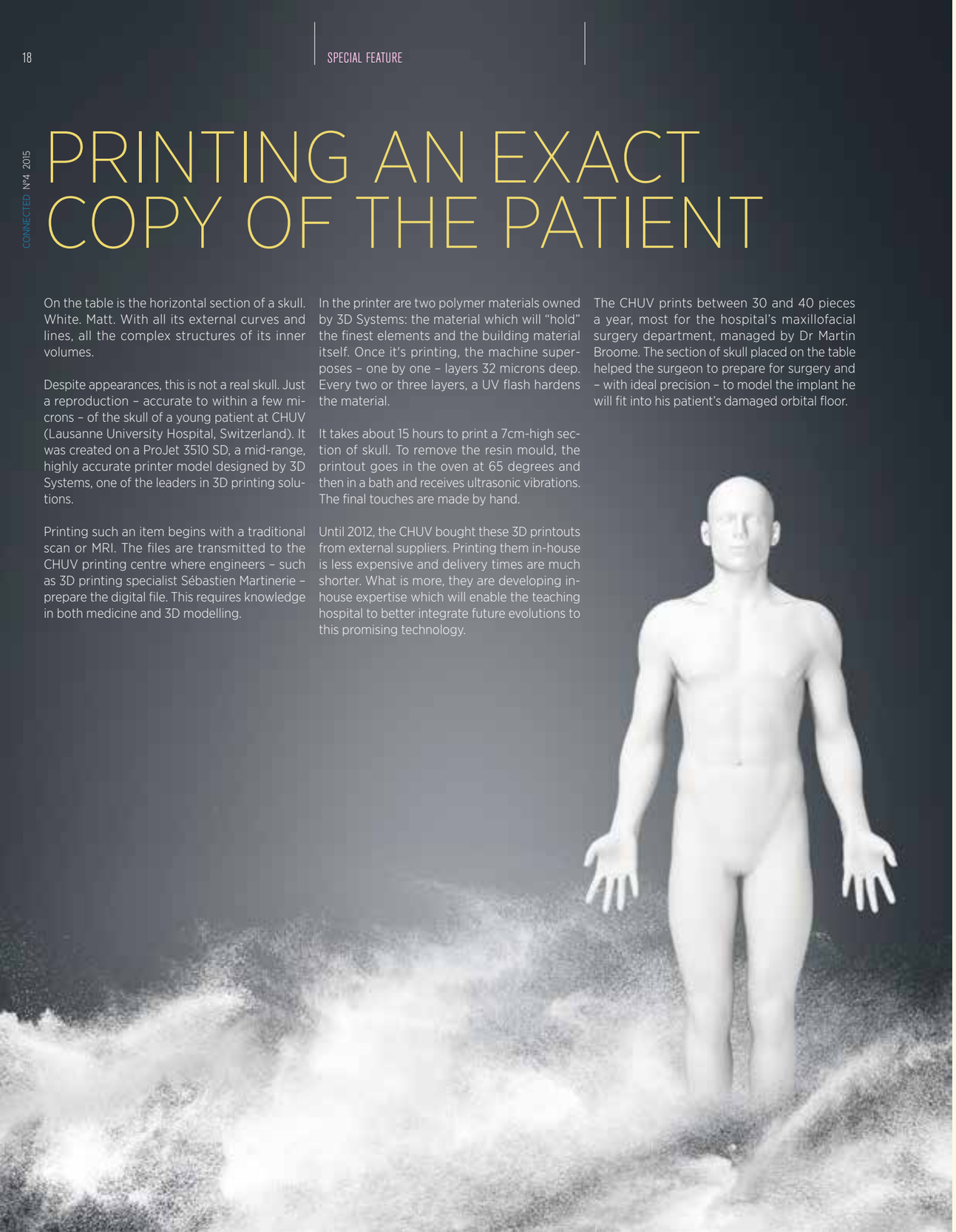
Printing such an item begins with a traditional scan or MRI. The files are transmitted to the CHUV printing centre where engineers – such as 3D printing specialist Sébastien Martinerie – prepare the digital file. This requires knowledge in both medicine and 3D modelling.

In the printer are two polymer materials owned by 3D Systems: the material which will "hold" the finest elements and the building material itself. Once it's printing, the machine superposes – one by one – layers 32 microns deep. Every two or three layers, a UV flash hardens the material.

It takes about 15 hours to print a 7cm-high section of skull. To remove the resin mould, the printout goes in the oven at 65 degrees and then in a bath and receives ultrasonic vibrations. The final touches are made by hand.

Until 2012, the CHUV bought these 3D printouts from external suppliers. Printing them in-house is less expensive and delivery times are much shorter. What is more, they are developing in-house expertise which will enable the teaching hospital to better integrate future evolutions to this promising technology.

The CHUV prints between 30 and 40 pieces a year, most for the hospital's maxillofacial surgery department, managed by Dr Martin Broome. The section of skull placed on the table helped the surgeon to prepare for surgery and – with ideal precision – to model the implant he will fit into his patient's damaged orbital floor.







### MEDICAL IMAGING

Materials: polymers. Printing of portions needed (bones, organs, foetus, tumours, etc.). These models help to prepare for surgery (for example, demarcating the zone to be removed) and/or implants. Also makes it easier to communicate between specialists, with patients and with students.

### EXTERNAL PROSTHETICS

Materials: polymers. Custom printing of supports, corsets, prosthetics or exoskeletal pieces, much faster and less costly than usual production. Perfectly adapted, these elements are also more comfortable for the patient.

### IMPLANTS

Materials: biocompatible (titanium). Easier and less costly printing of perfectly customised implants. They are easier to implant and are structured in a way that promotes integration with the bone, speeding up the healing process and mobility.

### SURGICAL GUIDES

Materials: biocompatible polymers. Custom printing of cutting guides. True to the surgeon's planning, accuracy is greatly improved for bone resection and implants.

## HOW MEDICINE USES 3D PRINTING

### ORGANS

Materials: cells, biomaterials (anionic polymer, synthetic hydrogels, etc.). Printing of living and functional organs. Eventually, they could mean organ donation is no longer needed. In the near future, the design of simplified or miniature organs could reduce or eliminate animal testing.

### SCAFFOLDS

Materials: biopolymers, iron/manganese, etc. Printing of bioresorbable structures which, once implanted, will support tissue reconstitution (bone tissue, for example) generated by the body itself. Once the tissue has reformed, the scaffold dissolves.

### TISSUE

Materials: cells, biomaterials (anionic polymer, synthetic hydrogels, etc.). Printing for pharmaceutical research or regenerative medicine in tissue engineering (skin, bones, heart, blood vessels and other), close to actual tissue. Teams have also printed cancerous tumours, helping to better study their behaviour.

**CLARIFICATION: 3D OR 4D PRINTING?**

As tissue is alive, it will evolve after 3D printing. It will grow, acquire functions and organise itself. When digital files incorporate this dimension of time from the very start, foreseeing an evolution, it is sometimes referred to as 4D printing.

# SCULPTEO, THE SUCCESS OF A FACTORY IN THE CLOUD

**“There began to be a lot of talk about 3D software, 3D objects and 3D printing in 2009” explains Clément Moreau, co-founder of Sculpteo. “For us, it was a new revolution in the history of industry. So we started to get ready for when the big wave would arrive…”**



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The grilles of AudioQuest NightHawk headphones are 3D-printed.

Clément Moreau created Sculpteo in Paris, France with Eric Careel (also founder of Withings connected objects) and Jacques Lewiner. The concept – as Moreau likes to summarise it – is a “factory in the cloud”. You upload a 3D file to the website, Sculpteo prints it and you receive the object in the post. There were already a few competitors (Shapeways was launched in the United States in 2008), but the concept was still very new.

The anticipated wave arrived and Sculpteo was not one to miss out.

Mid-July 2015 and the French company announces it has been chosen by the giant HP to be an exclusive partner. Sculpteo will produce what emerges from the “Sprout”, HP’s brand new generation of PCs for 3D creators.

*“Such an amazing acknowledgement,”* rejoices Clément Moreau. More like a confirmation. HP joins other leading names who have already entrusted their 3D printing to Sculpteo: eBay, Amazon, Orange, the French postal service and supermarket giant Auchan (who has just invested in the company).

Back in February 2010, Sculpteo had begun by targeting consumers. This helped the company build its image and test the market. But as expected, the market was not ready (creation and use of 3D files is still not mainstream). So the start-up reacted fast by opening up to professionals and by developing what was to become its trademark: software tools that considerably simplify the work of its users.

Today, these tools enable precise online control of each production stage. The uploaded 3D file can be checked. Cavities can be incorporated to reduce the quantity of materials used (and therefore the cost). A final rendering can be obtained to check – or change – the choice of materials, finish and colours (48 possible combinations). The user can also optimise the layout of objects in trays to reduce the quantity of materials used and printing time.

These control and improvement tools have also hit the mark with professionals. They even allow them to print end products, not just prototypes. For example, the American company AudioQuest prints the grilles for its new NightHawk headphones at Sculpteo.

Accessories for smartphones and tablets, small figurines, jewellery, unit production or medium production runs… Sculpteo can print everything, or almost. The object must measure less than 30 $cm^3$, cannot be a weapon and the customer must demonstrate ownership of copyright.

The potential is there. Sculpteo’s turnover doubles each year and demand is constantly increasing.

The company does not fear the success of personal 3D printers either.

*“On the contrary,”* asserts Clément Moreau. *“The more 3D printing enters the mainstream – as is already the case in the US where dedicated software is becoming as natural an item as an office suite – the more the demand for professional quality services increases”.*

Scan this QR code to watch how Sculpteo works

# FROM SCIENCE FICTION TO REAL LIFE

**Originally intended for industrial prototyping, 3D printing has become increasingly sophisticated and accessible to the public. It would be difficult to even imagine all that a family could print for themselves 10 years from now. Today, this technology already works for applications that were mere science fiction only a few years ago. Here are just a few examples.**

### FOOD

The very first trade show fully dedicated to 3D food printing, the 3D Food Printing Conference was held in April, in Holland. There are some particularly aesthetic perspectives, such as the superb sugar sculptures printed by The Sugar Lab (a start-up acquired by 3D Systems). NASA has also been studying this technology to prepare meals during long interplanetary space travel (they have already printed a pizza). Some futurists believe that by 2030 half of our meals will be produced on request by 3D printing.

### GUNS

The first functional gun was printed in spring 2013. Made of 16 polymer parts and a metal firing pin, it could shoot a 38 mm bullet. Its creators posted the 3D file on the internet. Since then, a large number of other models have been designed – even in metal – together with ammunition. The basic types can be printed for a few dollars on 1000-2000-dollar printers. In other words: by anyone. The US government hastened to prohibit the distribution of 3D files, whilst recognizing that it is impossible to prevent such activities.

### EGO

3D-printing has given a new dimension to selfies. You can create a statue of yourself that even the most egocentric dictators would happily adopt. It is all very simple: it takes only a few seconds to scan yourself, or with your partner or your family or friends and then select the size of the reproduction. The studio prints and, after some fine tuning, you get the highly detailed and identifiable masterpiece. The German company Doob 3D have placed their hi-tech scanning booths – the "Doob-licators" - in Dusseldorf, Berlin, Toyko, Los Angeles and New York (and rent them for special events). In Switzerland Minimoi.ch also provides a "3D selfies" service.

### FASHION

Shoes, dresses, jewellery, hats: fashion shows have adopted 3D printing for the last few years. Designers have been using it to explore ultra-complex, futuristic shapes. Printed objects are mainly used for decorating clothes, but a Californian start-up has decided to go even further. Electroloom finished their Kickstarter fundraising in June and propose printers that can create clothing. Need a T-shirt? Just hit Control+P!

### FURNITURE & DECORATION

Designers will be able to explore new creative techniques with complex structures and new materials. Armchairs, lamps, tables, bird feeders or even complete walls ... Everything can be created by CAD and "simply" printed. For the time being, furniture or other bulky objects are more expensive than from IKEA or those manufactured in Asia, but the time will come when a family will be able to print a cup to replace the one smashed by a clumsy child.





### EXTRATERRESTRIAL HOUSES

Transporting heavy and bulky material is a major obstacle to building houses elsewhere than on Earth. The European Space Agency and various industries (such as Foster+Partners architects) have been studying the feasibility of 3D printing using lunar soil. D-Shape, a robotized printer by Monolite UK Ltd. could use existing site materials, agglomerating them layer after layer with a binding solution. An entire building could be completed in a week. NASA is also interested in the application: it has just announced, together with America Makes, a $2.25 million dollar competition to build and design an entirely 3D-printed habitat for deep space exploration, including on Mars.

Scan this QR code to watch how the ESA plans to 3D-print a house on the Moon

# BEYOND CONNECTORS

By Alexis Malalan

**LEMO's long experience and solid expertise in the field of connector and cable assembly has now been extended by offering complete interconnection solutions.**

High quality cable assembly for research applications.

Since its creation in 1946, LEMO has been a success story, becoming a global leader in the field of reliable hi-tech connectors. After almost seven decades, the Group has added a further stone to its edifice. In order to anticipate future market trends and to offer new opportunities to its customers, LEMO acquired in June 2014 the US company Northwire, Inc., specialized in the design and manufacturing of custom cables for the medical, aerospace, defence and energy industries. Hence, LEMO is developing its own cables and is able to offer complete cable-connection solutions that are designed entirely in-house.

In fact, this new strategic direction is the result of long-term evolutionary development. Even though LEMO had not been manufacturing cables in the past, the company has been assembling its connectors onto carefully selected cables from outside suppliers. Several LEMO subsidiaries have thus been specializing in cable assembly, in particular in Germany and the United Kingdom.

*"We've been doing cable assembly here since the seventies,* says Mr Wilfried Mathemeier, managing director of LEMO Elektronik GmbH in Munich. *Since then, we have been delivering complete solutions, including cables and connectors, to a large number of companies in the automobile, medical and broadcast industries. We also advise smaller customers in other sectors, mainly when they need to test their products."* Customer satisfaction has always been the first priority. Faithful to its quality requirements, LEMO has always taken extreme care over even the smallest details: each and every cable assembled by LEMO Germany is rigorously tested.

For LEMO (UK) Ltd, cable assembly started in 1994. *"It all began with fibre optic connector R&D and requests from customers to provide complete fibre optic cable assemblies, due to their concerns about handling the technology at that time,* specifies Richard Thomas, managing director. *Then, with the increasing number of customer requests for hybrid electrical and fibre assemblies, we expanded our services to cover the full LEMO range as well as other types of connectors, building our resources and skills accordingly."* The first major project was particularly interesting: *"It included cable and connector assemblies for the ISIS neutron collider, for which the dimensions were critical. The mission was successfully completed and we have continued to be a key supplier for ISIS ever since. LEMO UK has continued to develop its know-how in the field, 'namely by employing and developing highly experienced specialists and by investing in the necessary production and test equipment as well as CAD systems for designing connection solutions to suit each customer's application."*



Triaxial broadcast connector assembly in Spain

By acquiring Northwire last year, LEMO will be able to go even further. It is a natural, logical development. But what exactly are the advantages of offering 100% LEMO solutions?

From now on, whenever a customer contacts LEMO specialists with highly specific demands, the Group has all the know-how and necessary technology to be able to design a fully custom solution, accurately fitting the customer's needs. LEMO is planning to develop its cables and connectors jointly, to be able to offer an even higher level of customization and to boost innovation.

The new positioning will strengthen LEMO's global reputation of offering high quality reliable solutions. By manufacturing everything in-house, LEMO is now capable of fully controlling the whole value chain. Quality is assured not only for connectors and assembly but also for the cables. Customers can be sure to benefit from highly reliable solutions. This guaranteed quality is likely to attract a number of companies in very demanding markets.

No bad surprises, a lot of added value and new opportunities, maybe even new markets. Everyone will benefit from LEMO's global approach to interconnection.

"THIS NEW STRATEGIC POSITIONING WILL ENABLE TO FURTHER IMPROVE THE QUALITY AND CUSTOMIZATION OF LEMO'S PRODUCT OFFERING, AND CUSTOMERS ARE ALREADY BENEFITTING FROM THESE NEW OPPORTUNITIES."

# FROM FREEZING COLD TO SEARING HOT

By Alexis Malalan

**Okazaki is one of these companies that raise technology to new levels of perfection and reliability. Its temperature sensors are capable of operating in extremely hostile environments.**

REDEL P connector designed for OKAZAKI





"MINERAL INSULATED CABLES RESIST TO A HEAT RANGE OF -269°C TO +2200°C AND MEASURE TEMPERATURES IN A ROCKET ENGINE AT FULL CAPACITY OR IN THE REACTOR OF A NUCLEAR POWER PLANT."

Okazaki was founded in Japan, back in 1954. Since then, it has never stopped growing, opening new production plants over the decades. Today the company is a global leader in the field of heating systems and temperature measurement devices. It develops highly reliable and heat resistant temperature sensors and cables.

These special devices are adapted to the most demanding environments, with extremely low or high temperatures. They are capable of operating in extremely varied atmospheres, such as oxidizing, neutral or vacuum atmospheres.

At the top end of the range, there are thermocouples. These devices are made for measuring and controlling temperature with the help of special metallic conductors. They are used in the most complex industrial processes, but also in very simple everyday applications, such as the thermostats that we use at home.

Yet, Okazaki's thermocouples are far from ordinary. They employ a unique technology that took years to perfect: mineral insulated (MI) cables. It enables them to resist to a heat range of -269°C to +2200°C and to measure temperatures in as hostile environments as a rocket engine at full capacity or the reactor of a nuclear power plant.

To meet these challenges, Okazaki thermocouples are both extremely reliable and innovative. Actually, the Japanese company has gone so far in the field that it holds the world record for the smallest thermocouple. With a thickness as low as 0.08 mm, AerOpack Nano is finer than a human hair!

In order to improve the efficiency of its process industry thermocouples, Okazaki has also developed a high added-value product, the Vortexwell thermowell. This uniquely designed and extremely efficient system not only protects the sensor from hydrostatic and aerodynamic forces and chemical effects of process fluids, but also does not require a velocity collar thus reducing costs of installation and maintenance, whilst providing highly accurate temperature measurement in particularly hostile environments.

Today, customers all over the world are convinced by this small concentrate of thermosensing technology. You will find Okazaki products in all applications that require high security and reliability, such as space shuttles and satellites, nuclear or thermal power plants, the automobile industry, or photovoltaic installations. No matter what the conditions are, these new type of temperature sensors never stop pushing their limits to the extreme.

### 10 YEARS

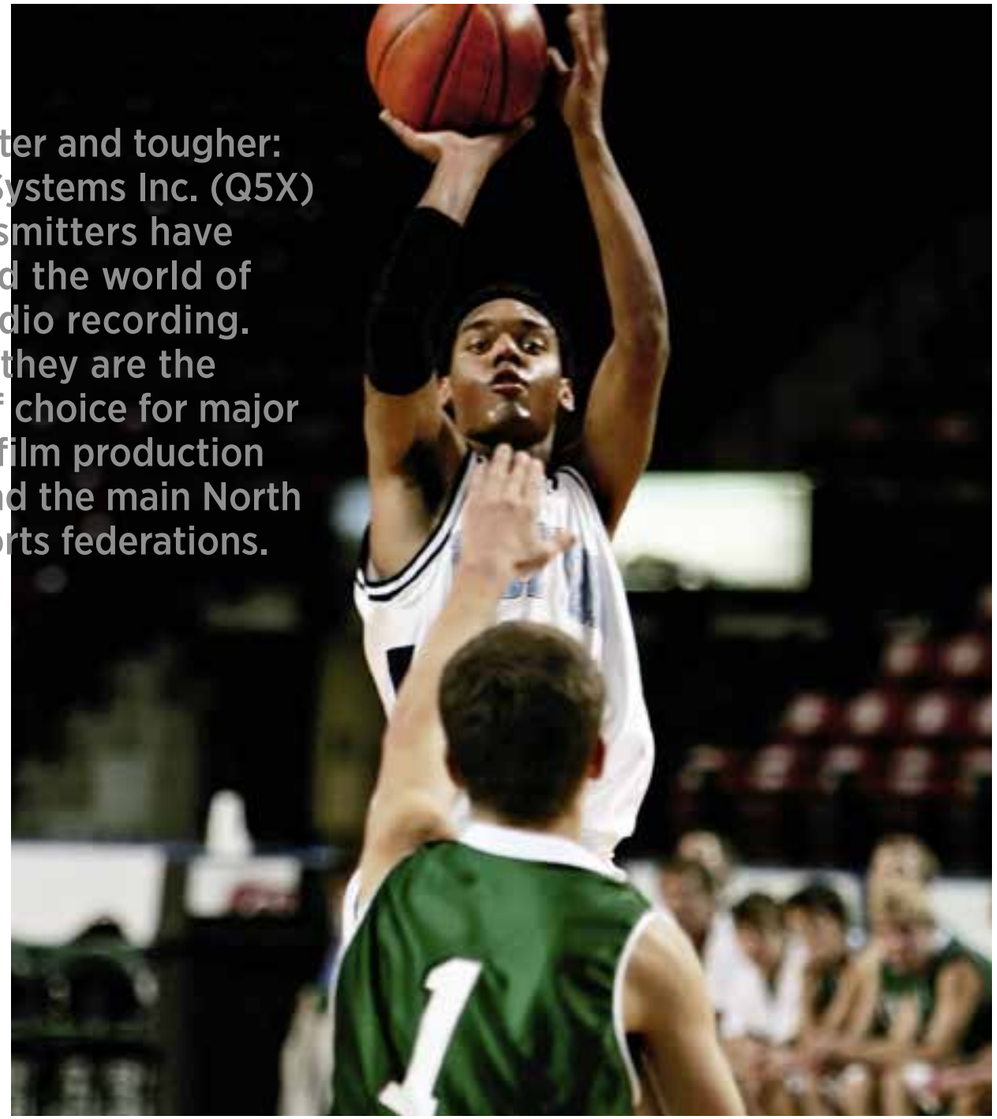
The LEMO-OKAZAKI cooperation began over ten years ago. LEMO connectors are used to connect thermosensors to the measurement unit.

Scan this QR code to go to Okazaki's website

# QUANTUM5X, EXTREME MICS

By Renzo Monti

**Smaller, smarter and tougher: Quantum5X Systems Inc. (Q5X) wireless transmitters have revolutionised the world of broadcast audio recording. Increasingly, they are the transmitter of choice for major TV channels, film production companies and the main North American sports federations.**



Our story begins at the turn of the 21st century. Allen Kool, a Canadian music and audio-visual production engineer, met an American Major League Baseball (MLB) representative who wanted to place wireless microphones on baseball players and umpires. The idea was to enable them to communicate during games and to make viewers feel as though they were on court with the players, using high quality recordings. However, there was no device reliable, tough and light enough to be used in the thick of the action.

This meeting led to the development, in 2002, of a revolutionary wireless micro transmitter: the QT-256. Weighing a little over 40 grams, with the dimensions of a Zippo lighter, it is both shock-proof and water-resistant. It operates in temperatures from -10 to 45 C°, offering excellent battery life. It can be placed on any athlete, and relays everything they say without getting in their way. The same year, Allen Kool set up Q5X with a handful of devoted engineers. Based in London, Ontario, the company started producing and selling the world's smallest wireless micro transmitters. The first model worked to perfection, and was an instant hit.

In 2015, many developments later, the QT-256 remains unique. From the start, Q5X devices have been equipped with LEMO connectors which connect the little transmitter boxes to the microphones and are used for charging the batteries. For Steve Matheson, Director of Sales and Operations at Q5X, this partnership was a no-brainer: *"We needed the toughest, most reliable connectors, and they needed to be very small. LEMO understood our devices perfectly and was able to provide the best possible solutions,"* he enthused. *"It's thanks to these connectors that we are able to produce the smallest micro transmitters in the world!"*.

Now, the various models produced by Q5X rise to new challenges every day. In June, at the request of American TV channel Fox Sports, Q5X in conjunction with Professional Wireless Systems placed microphones in every hole along the course of the 115th US Open. The exceptional battery life of these new, specially adapted micro transmitters ensured they remained operational for the entire day with no breaks. This was a deal-breaker, as technicians are not permitted to go onto the greens to change batteries. For the first time, viewers were able to experience the very essence of a golf tournament, alongside the players themselves, in high quality sound.

Thanks to the success of the QT-1000 PlayerMic and its subsequent versions, Q5X now provides microphones for the NFL (American Football) and NHL (ice hockey) players, as well as the NBA (basketball), for whom the model was initially developed. The PlayerMic is shock and sweat resistant, and flexible; it will not injure players, even if they fall on it. At the last NBA playoffs, millions of viewers were able to hear excerpts of what basketball star LeBron James was saying to his teammates, and experience the game as if they were right there on the court.

Another feat in a completely different world: the Rockettes, the famous tap-dancing troupe, have had the TapShoe Mic fitted to their shoes. At the end of 2014, 36 dancers wore these micro transmitters for 30 performances of the famous Christmas Spectacular, one of America's most iconic and popular shows, which takes place every year at New York's Radio City Music Hall. Steve Matheson joked: *"We reduced quite a few transmitters to pieces before we got this model right! Of course, the quality of the components is crucial. But we also need to understand the context. That is one of our strengths at Q5X: our team didn't know the Rockettes, but are now tap-dancing experts!"*.

Q5X micro transmitters are also a key part of the movie industry, used in the helmet of the latest Robocop, for example, and in those of the actors operating the giant robots in blockbuster Pacific Rim. The new Q-256 AquaMic, which Is completely waterproof, is already used in many water sports and will feature at the 2016 Rio Olympic Games.

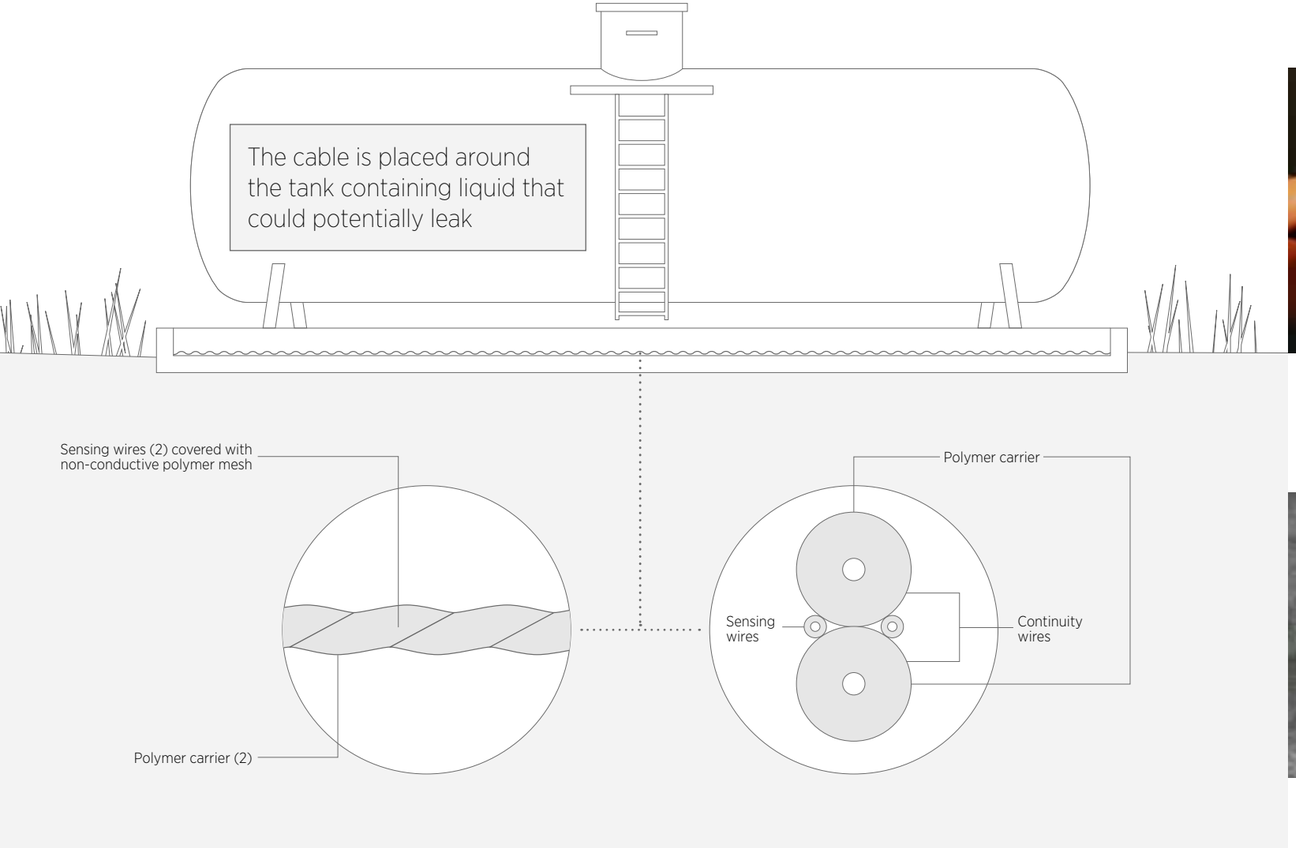
With an annual growth rate of 20%, this little company has every reason to be confident. It is starting to expand outside North America, with very positive results for tests carried out both in the English rugby and Australian football leagues.

Scan this QR code to see how Q5X microphones captures Lebron James in-game vocal performance


Microphone fitted with LEMO screw coupling connector.

# DETECTING LEAKS, SAVING LIVES

By Brigitte Rebetez




A conductive Fluid Sensing Cable.

The RLE F200 Zone Controller.




**In a world of dramatically increasing demand for information and interconnectivity, facility uptime and data reliability have become a major concern. Enter the cables and sensors of RLE Technologies, specialists in leak detection and facility monitoring against environmental threats and whose solutions are playing a key role in preventing information, material and human disasters.**

Since its creation in 1984, the US company has installed many kilometres of intelligent cables all over the world. With the increasing demand for facility monitoring and data protection, RLE Technologies' proven expertise has been extremely successful as demonstrated by record sales to start 2015.

RLE Technologies' product fall into two main lines: Falcon and Seahawk with both product lines being developed, manufactured, and assembled in the USA.

The Falcon line of products provide monitoring solutions against environmental threats (humidity, temperature, air flow, pressure variations, smoke, gas, etc.) and are employed to monitor and control a number of highly sensitive facilities, such as data centres. They detect any internal environmental change that is likely to provoke a collapse of an entire network of a company or a distribution service system.

The SeaHawk line is engineered to detect any form of liquid leak – a simple risk that can often cause serious consequences. A small water leak may happen anytime, anywhere – caused by a damaged standpipe, a frozen pipe, an overflowed sink or toilet, or a roof leaking due to harsh weather conditions and so on. They are used in laboratories, museums, libraries, and more specifically IT departments and databases where water leaks into electrical equipment could be disastrous.

SeaHawk solutions are also designed to protect against false alarms caused by non-liquid contamination (dirt, debris…) and there is even a version that is resistant to rodents.

RLE Technologies' emphasis on innovation has been rewarded by 11 patents and the team is continuously developing new solutions.

Headquartered in Fort Collins (Colorado), RLE Technologies' engineers are currently working on an extension of the Falcon product line: an innovative wireless solution (Lattice wirefree network) will soon be available. The Lattice Wirefree Sensor Network will include all the sensor needed to fully protected a sensitive facility but will do it with less signal conflict, improved sensor battery life, and a number of additional benefits. Additionally, RLE is working on an innovative new leak detection cable engineered to detect multiple simultaneous leaks.

RLE Technologies has also been working on another promising development project, in cooperation with LEMO: a revolutionary hydrocarbon (petroleum) leak detection cable.

Imagine an above ground fuel tank refuelling mountain communities. Damage to this tank could cause leakage likely to contaminate both the soil around the tank and potentially the closest water source or river… Then, imagine a hydrocarbon leak detection sensing cable, placed between the tank's inner and outer shell. Any problem will be detected before even a droplet of oil could escape into the environment. One small step for man, preventing a disaster for the planet and costly clean-up for the petroleum company.

This hi-tech cable does not yet exist, but within a year it will be much more than mere science fiction. It will protect not only the environment, but also human lives. Just think about the consequences of a leakage from an airport fuel tank, an offshore oil rig, or any other place where a single spark could cause a devastating explosion.

# THE DUTCH CONNECTION

By Corine Fiechter

LEMO Benelux cable assembly workshop.

**Ten years ago, LEMO opened a new subsidiary in Holland. Since then, they never stopped growing. In only 10 years, LEMO Benelux has become a reliable partner for hi-tech companies, the subsidiary has also come to play an increasingly central role in offering complete LEMO cable-connector solutions in Europe.**

LEMO Connectors Benelux headquarters near Amsterdam.

When Niels Zonneveld sold his first LEMO connectors at the end of the nineties, he was working for Getronics, the then LEMO distributor in the Netherlands. At the time, the Benelux was the last European region without a LEMO subsidiary. The situation changed in 2005 with the opening of a Dutch subsidiary, staffed by only two people. Niels Zonneveld, who was one of the two, is now general manager of LEMO Connectors Benelux, covering Belgium and Luxembourg as well since 2007.

The company started growing and serving its customers very quickly. *"In 2009, we started cable assembly for one of our largest customers in the broadcast industry, especially for professional camera systems, a key sector in our market."* Since then, we have extended this service to all connectors and customers" tells Niels Zonneveld. At the same time, the subsidiary has been developing its storage activities to improve responsiveness.

*"Product quality and reliable delivery are the major expectations of our customers. Being close to them is essential to be able to offer maximum flexibility. The creation of LEMO Connectors Benelux has greatly contributed to improved logistics, especially since we have never stopped expanding our storage capacity. We have moved already twice since 2005, to have larger surface areas. In a few years, we've grown from 128 $m^2$ to over 1000 $m^2$ and we are running out of space again in Heemskerk, at about 30 km from Amsterdam."*

This growth is also reflected in other figures: in 10 years, the subsidiary's turnover has multiplied by six, and staff numbers have increased from 2 to 24, with half of them working in stock and assembly.

Nevertheless, the company has managed to retain a family atmosphere amongst staff and to continue to build strong relationships with its customers. *"Thanks to these close contacts, we are in a perfect position to understand their requirements. For instance, we have recently modified a custom design: by selecting a more expensive material (Titanium), we could reduce the need for chemical treatments for specific needs, This reduced our lead time, increased delivery reliability and, as a bonus, reduced the cost price, In such a process, we act as an interface between the customer and LEMO R&D engineers in Switzerland. Working for LEMO is great. Being able to deliver this kind of special products is the icing on the cake!"*

LEMO Connectors Benelux has also been managing, since early May, the European stock of LEMO's newly acquired US company, Northwire's cables. There are about sixty different types of cable that LEMO Benelux can deliver to other European LEMO subsidiaries in just one day. All this with unfailing support, since they also provide assembly services for companies that lack local infrastructure.

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