



CONNECTED

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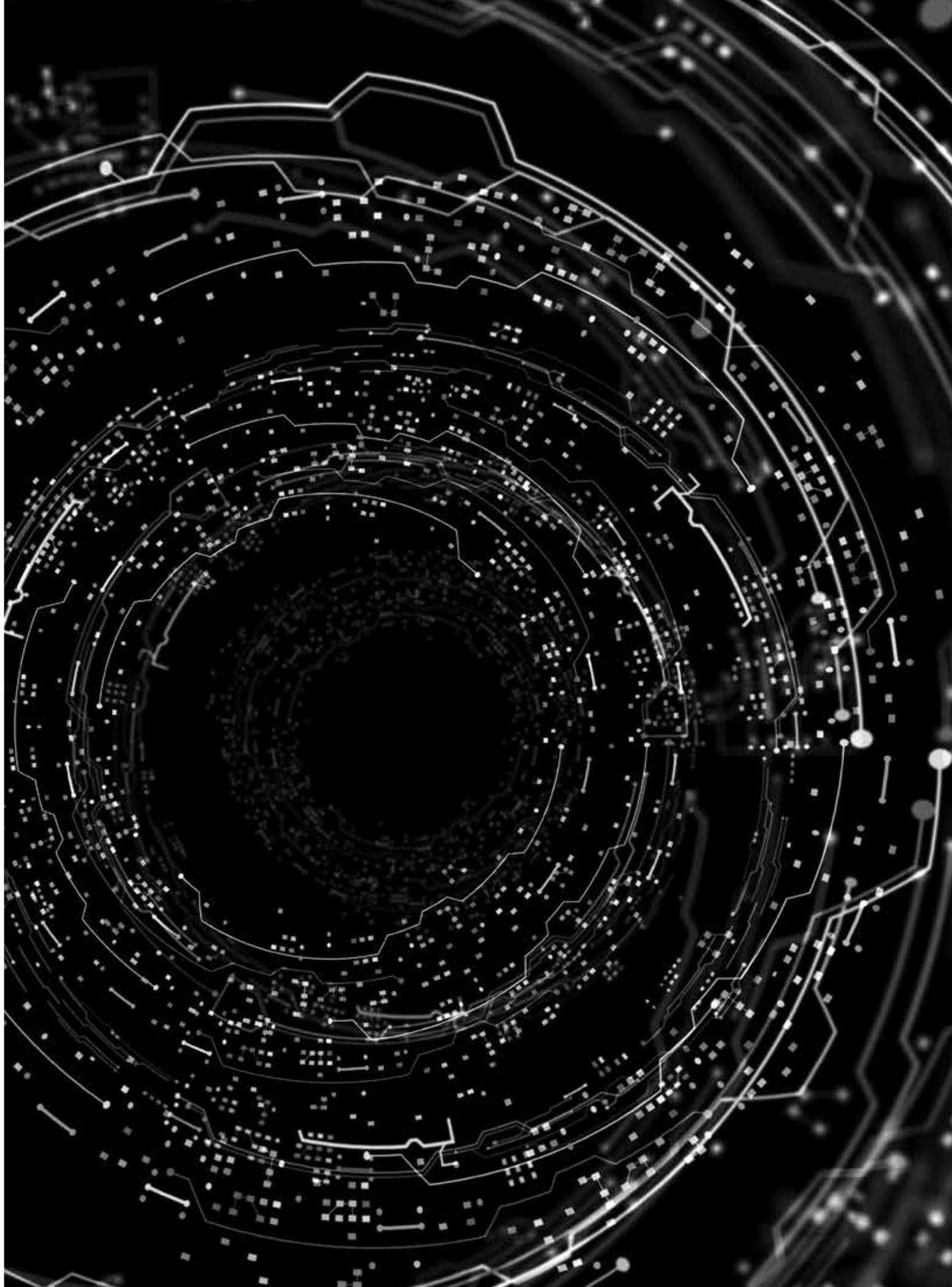


Innovation is in our Nature

Micromega: From Nanotechnology to Astronomy

ARRI: New Master Grip on Film-making





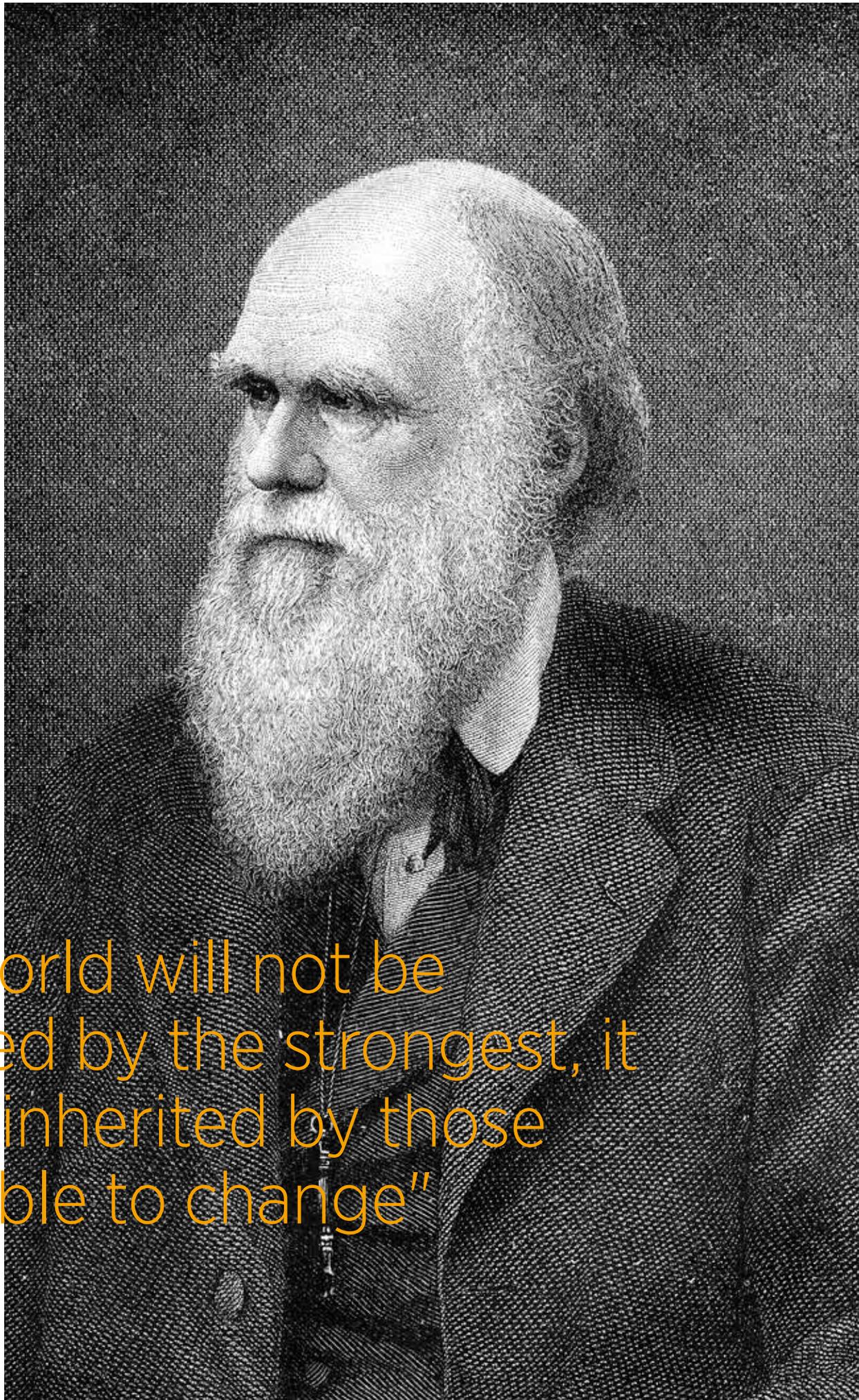
Few companies can claim to have invented a global standard and LEMO is one of them.

Exactly 60 years ago, our founder Léon Mouttet created the Push-Pull connector, a truly innovative product that has stood the test of time. Easy-to-handle and safe, his invention can be found all over the world, from ocean beds to outer space, as well as every location in between. From freezing cold to blazing heat, from the most benign to the harshest, from the most sterile to the most polluted environment, from silence to roaring noise!

Innovation is in the nature of every living creature: it is by continuously innovating that nature shapes its evolution. It is also part of every human being, an instinct almost as strong as our fear of change! However, there is a giant gap between a creative person and a company that keeps innovating over many decades. How do you get there?

This CONNECTED issue refers back to the Push-Pull system's anniversary (page 26) and includes interviews with specialists on the principles of innovation (see special feature on page 10). Just like our previous issues, this new CONNECTED also presents some of the latest advances in technology. Above all, it pays tribute to the inventors and innovators – these men and women who see the world with all its imperfections and take action to make it a safer, healthier, better place.

Alexandre Pesci
CEO LEMO



"The world will not be inherited by the strongest, it will be inherited by those most able to change"

Charles Darwin

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1. COMPANION SUITCASE

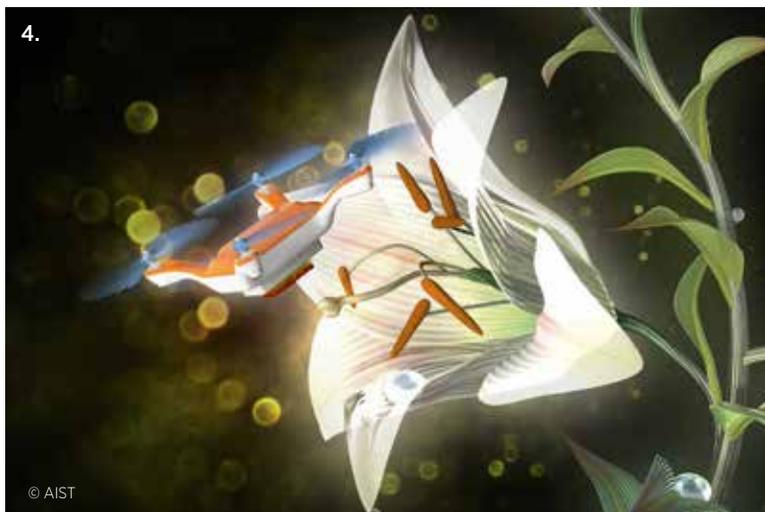
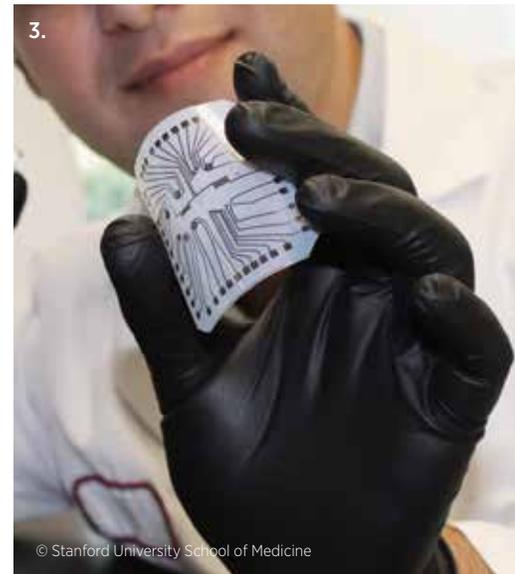
As of 2018, Piaggio is planning the market launch of a drone suitcase capable of following its owner. The strange device was developed by PFF (Piaggio Fast Forward), the R&D section of the Italian scooter manufacturer. Gita (its pet name) is equipped with two wheels and it can rotate. It keeps its balance thanks to a gyroscopic system similar to the one used for gyropodes. If you have to run to catch your train, the suitcase is capable of attaining 35 km/h and will keep up with you, no problem. It has approximately 8 hours of autonomy and it can transport up to 18 kg.

2. THIS DEVICE WILL SELF-DESTRUCT IN 10 SECONDS

In the case of theft or loss of a PC or a smartphone, it will soon be definitely possible to prevent access to sensitive data. Scientists from the King Abdullah University of Science and Technology in Saudi Arabia have just accomplished an impossible mission: creating devices capable of self-destructing with the help of a polymer which deforms components differently when heated. The result is fatal to any nearby microchip within 10 seconds. A very weak electric current, either remotely controlled or triggered by the device itself in case of theft, is enough to induce the reaction.

3. DIAGNOSTICS LABORATORY CHIP FOR 1 CENT

Scientists from Stanford University School of Medicine have developed a "lab-on-a-chip" that can analyse blood cells for quick detection and diagnose of many diseases. Capable of isolating blood cells before classifying and counting them, this system enables early detection of cancer cells. Even more important are the manufacturing techniques used: it can be produced in 20 minutes at the cost of about 1 Euro cent. Such a chip could change the life of millions of people, who in developing countries are diagnosed too late for lack of staff and material.



TECH-BITS FROM AROUND THE WORLD

5.



© Honda

4. MINI-DRONES TO HELP BEES

A team from the National Institute for Material Science in Tsukuba, Japan, managed to pollinate flowers with a miniature drone purchased off-the-shelf for about 100 USD. The bottom of the drone is covered with horsehair, reproducing the hair on bees' legs. This surface is then coated with an ionic adhesive gel. The drone lightly brushed the male part, then the female part of Japanese lilies, to collect and deposit pollen. Once these drones become autonomous, they could cooperate with pollinating insects like bees whose population is mysteriously and alarmingly declining.

5. FALL-PROOF MOTORCYCLES

Honda have just unveiled a new motorcycle prototype equipped with a balance control system. It is capable of remaining upright on its wheels on its own, with or without the driver. The biker can even stand up on the footrests of the intelligent bike without losing its balance, thanks to a gyroscopic system that reacts to the movements of the passenger. Even if other manufacturers have recently also developed similar technologies, the Honda bike offers the extra advantage of being capable of quietly following its owner, just like the Gita suitcase (see page 7).

6.



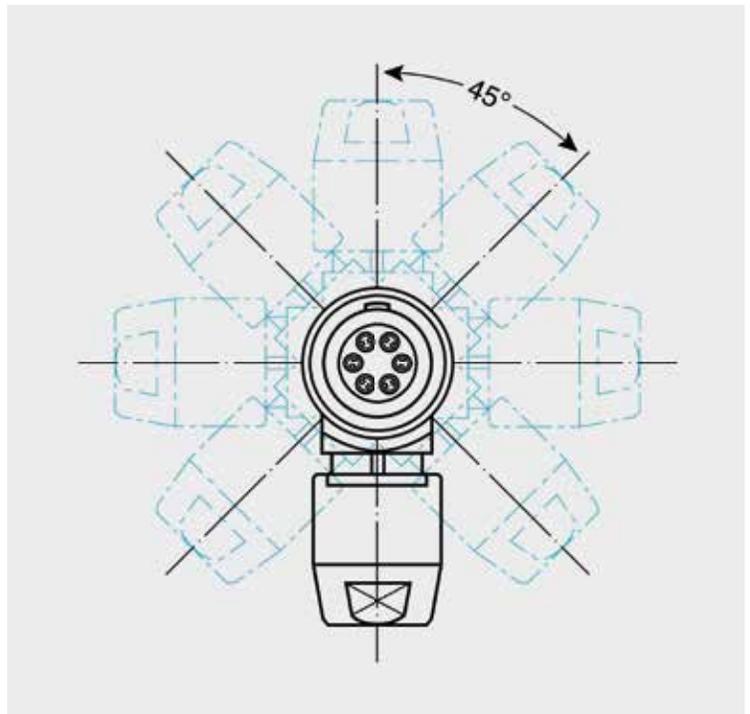
6. BOATS WITHOUT PILOTS BEFORE AUTONOMOUS CARS?

The autonomous car war rages on: Uber has just been accused by Alphabet of having stolen their drawings, Intel has just acquired Mobileye for 15 billion dollars. However, large vessels may outpace them, sailing all seas and oceans of the world already by 2020. A few months ago, Ocean Blue, the R&D department of the Rolls-Royce conglomerate presented their project of container ships navigating without a crew or a captain. Since then, the project has been steaming ahead. The ships will be piloted from an on-land control room and crew space will be used for transporting goods. This revolutionary solution would help to reduce the number of vessels, reducing fuel consumption and building materials.

ADAPTABILITY TO THE POWER OF EIGHT

By Corine Fiechter

LEMO's new right-angled Anglissimo connectors offer unprecedented flexibility to users, who can set the cable outlet position in eight different positions. They are the successful result of an internal innovation process.



Right-angled connectors are well-known by users and are typically used for space-saving reasons or to avoid cable snagging issues. Upon customer request, LEMO has been adapting the cable outlet angle to either a 3, 6, 9 or 12 o'clock position by using specific components, according to the selected position. Anglissimo pushes the concept one step further.

Anglissimo is the name of a brand new FSG series connector. With these connectors, LEMO can now offer more flexibility: no less than eight outputs at 45° intervals that the users can set themselves, thanks to a device which is in the process of being patented. This new device has the added benefit of eliminating the need for special components for each and every variant.

This new idea came from LEMO Germany. The German engineering team worked out the basis of the concept through an internal competition, as part of the innovation process, in which all the LEMO subsidiaries could participate. *“One of the major challenges was to attain a certain torque, in order to guarantee the same resistance as that of our existing connectors”*, explains Noman Hashemi, technical support manager at the LEMO headquarters in Ecublens, Switzerland. Mission accomplished, since Anglissimo connectors are even more robust than some of the previous designs.

In the summer of 2016, the LEMO teams had to tackle another problem: time. Very enthusiastic about these new “8 in 1” connectors, ARRI, a leading company in the field of professional cameras (see article on page 20), requested a first series of prototypes for an exhibition in September of that year. The complete new outer shell design of Anglissimo was developed in record time, whereas the insulator, contact block, cable collet and nut used in this new range are all standard components already in existence.

Directly off the production line, the first prototypes were delivered just in time to ARRI who tested them promptly. Meanwhile, in Ecublens, LEMO continued the internal tests and approval process. Later that same year in November, Anglissimo connectors were already validated and ready to be launched onto the market.

“We started off with the 0B size, explains Noman Hashemi, closely followed by the 2B version for the Chinese railways, then the 1B and finally the 00. As soon as the design and the drawings were approved, we launched production, even before we got the first orders, so that we could have them in stock immediately.” However, the development process has not come to an end for him and his team, as they are already working on a new IP 68 watertight version, by adapting the T Series. |



ANGLISSIMO AT A GLANCE

- Orientable in 8 positions
- Push-Pull latching system
- Multipole 2 to 32 contacts
- Several keying options
- Operating temperature range from -55 to 250 °C
- IP50 watertight
- Screening >75 dB at 10 MHz/
>40 dB at 1 GHz
- For Ø 1 à 9.9 mm cable diameters



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IS IN OUR
NATURE!”

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PROMOTING A CULTURE OF INNOVATION



We spoke to Laurent Haug, entrepreneur, investor, writer and renowned innovation specialist about innovation and the impact of new technologies. For him, innovation is not necessarily related either to technology or to the future! It should first and foremost be thought of as a natural phenomenon that all humans must understand to survive.

Interview by Renzo Monti

Laurent Haug, could you give us your most general definition of the concept of innovation?

Innovation is a natural Darwinian phenomenon. For a project related to this subject, I consulted a biologist and have drawn striking parallels! Survival depends on the ability to adapt constantly, therefore to innovate. If you think of innovation as a phenomenon, you are faced with an ongoing Darwinian show.

Is this show a comedy, a drama or a tragedy?

A play in three acts. First, there is the initial, rising stage if we are talking about enterprise. You have to prove yourself, take risks, venture into the unknown. To me, this is the most interesting stage. After the rise, there follows consolidation, preserving power and status. Finally, there is fall: we get over confident, become blind and lose agility by wanting to preserve our comfort. We put on weight and we are overtaken by those

who are faster! What is amazing in society is that all entities are at one of these three stages. You can observe this phenomenon at the level of countries, companies and even on an individual scale. At a geopolitical level, China and Korea are rising, USA have reached the end of domination and have started falling, France, Italy and Greece have been destroying themselves.

So it is a tragedy indeed!

No, it isn't, because it is cyclical. China had already been a great power in the past, before declining and now rising again. Nokia used to be a company considered untouchable, before dramatically declining with the emergence of smartphones. These cycles occur when we forget that it is taking risks that generates value. Risk is the foundation of innovation. In the world of technology, Microsoft is a good example. They went through a crisis starting in the mid-nineties,

when the internet changed everything. They were overtaken by Apple and Google. Now they are coming back, because they have finished their decline. They have questioned themselves and are now ready for a new start. They managed to create fresh impetus, whereas Apple seems to be losing momentum.

How do you explain the decline of such strong companies?

Simply, because these companies are made up of human beings. It is hard to fight again for something that you have already conquered. Innovating is exhausting. You have to accept to live with uncertainty. The fact of not knowing where you will be in six months, whether the market will want to take what you are working on. It is hard to maintain the same intensity even when you have reached the top, never to rest, to continue the sleepless nights. Because this is what you need to do to create a revolutionary product! I think there is a certain logic in all this, just like in the theory of evolution. There is a regulation phenomenon. When you have a lot of resources, the hunger that drives your quest for more weakens. This leaves more space for the others and for redistribution of wealth.

Is innovation always closely associated with uncertainty?

Yes, uncertainty and risk go hand in hand with innovation, there is a strong link with change and survival. A person living in a country at war and hitting the road because his house is being bombed is innovative: he has no other choice but to reinvent his life, to start the future with a clean slate, risk everything all over again. In a way and through no fault of their own, refugees are entrepreneurs and innovators. A person who lands in New York with a single dollar in his pocket will have to innovate. This is how 65% of the top managers of US technology corporations are first or second generation immigrants. They often had no other choice but to build themselves a better future. A rich person, on the contrary, will tend to ask for help from the others to solve his problems, or write cheques to get rid of them. ▶

Laurent Haug doing what he loves: ▶
exchanging ideas on innovation.

"SURVIVAL
DEPENDS ON
THE ABILITY
TO ADAPT
CONSTANTLY"



"THERE IS NOTHING SUPERNATURAL IN INNOVATING"

INDUSTRIAL (R)EVOLUTIONS

Human beings never stop innovating and it is industry that both drives and benefits from innovation. In some cases, industrial evolution takes on such dimensions that it is referred to as a revolution. It is of course not easy to distinguish between the two, when you experience the phenomenon yourself. Some think that we are living the start of a 4th industrial revolution. Some others deem that the current technological advances fall within the 3rd industrial revolution built on electronics and computer science.

Unlike the first three revolutions, the fourth one does not use a new type of energy. It is characterised by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres. Its main vectors are cyber-physical systems, these enabling technologies that combine the physical and digital worlds in order to create a network of intelligent objects that are in constant interaction.

Internet, communicating sensors, cloud computing, Big Data and intelligent objects connect to create these systems that can potentially become autonomous, remotely controlled, capable of self-diagnostics, adapting and improving. When applied in an industrial context, all this is materialized by "smart factories", where all the various tools and workstations integrated

in the production and supply chain communicate permanently. These factories are capable of producing more easily, with more transparency and personalization. They can do it in co-operation with other factories or partners, with optimized resources, including energy.

The evolution of digitalization and its related technological progress is a new revolutionary step, especially as far as its conditions are concerned. It happens at an unprecedented pace and it is rather exponential than linear. Specialists are taken aback by the developments and so are governments and legal regulations. Major effects can be felt, even before we start preparing for the changes. The discrepancy is even greater, because the effects are spread out across the globe. Nowadays, a single software or application may, within a few months, question tens of thousands of jobs all over the world (travel agents, taxi drivers...).

Just like other revolutions, this one also has other major effects on society. For instance, it affects the way countries are governed (cyberdemocracy...), even the election of a government (think of the influence of social networks on the events of the Arab Spring or the election of Donald Trump); access to information (online media, blogs, "fake news"...) and knowledge

(massive open online courses ...); the relationships between countries (cyberspying, cyber wars...), the protection of privacy and health (cybernetics, genetic manipulation, synthetic biology...) and many more.

At best, this new revolution will have a positive effect on the environment, improve our living standards, better distribute knowledge, resources and wealth. The worst case scenario is nothing less than accelerating the end of mankind! The exponential development of artificial intelligence and networking objects could result in "machines" deciding about progress, relegating humans to the rank of accessory, to be retained or not. A possible outcome that would send a shiver down the spine of not only science fiction enthusiasts, but has also been alarming well-known personalities like Stephen Hawkins or Elon Musk. | Nicolas Huber

Is their a typical innovator profile?

Scientists have described innovators as people fascinated by a problem that is impossible to solve. Walt Disney wanted to make people happy... Such a project will never be completed! It seems that you need to be motivated by an unattainable objective. Some want to solve impossible problems, such as peace on earth or hunger. Some others are motivated by personal failure, a particular psychological state, such as having experienced reject or lack of understanding and want to prove that they are valuable by accomplishments that will be recognized by the others. Steve Jobs and Larry Ellison have both been adopted and maybe this was what contributed to taking them so far.

How about talent and genius?

Talent is not enough, there is nothing supernatural in innovating. When looking at the past, we always get the impression that things just couldn't have possibly happened in a different way. Still, if you look at the career of someone like Steve Jobs, you can tell that his success was the result of hard work, extraordinary persistence, the capacity to select talented people as well as some good luck and timing. Hundreds of other people were making their own way simultaneously and they never became famous, because they didn't succeed, not all the conditions were met. There is no clearly outlined destiny as such. There are daily new challenges, we invent our future together every day. ▶

1stLate 18th, early 19th century

MECHANIZING PRODUCTION

Vector coal

Innovations steam engines, weaving machine, railways...

Social effects factory work, rural exodus, rise of the middle class, shortening of distances...

2ndLate 19th century

MASS PRODUCTION

Vector electricity, gas, petrol

Innovations combustion engines, steel, artificial textiles, fertilizers, colouring, telegraph, telephone, mass media...

Social effects assembly lines, transports (aircraft, automobile), instant communication, global information...

3rd2nd half of the 20th century

AUTOMATION OF PRODUCTION

Vector electronics and computer sciences

Innovations electronics (transistors, microprocessors...), computer sciences, robotization, digital networks, nuclear science, miniaturization, the conquest of space...

Social effects urban exodus, teleworking, elimination of distances...

4thEarly 21st century

SMART FACTORIES

Vector cyber-physical systems

Innovations web, cloud computing, Big Data, 3D printing, enhanced reality artificial intelligence, Internet of Things, autonomous vehicles, nanotechnologies, quantum computing...

Social effects free interpersonal communication (e-mail, social networks, Skype...), digital and on-line services (Netflix, Amazon, Uber...); new medical technologies; privacy threats...

You say that innovation has nothing to do with the capacity of predicting the future. In the corporate world, isn't anticipating future markets the key to success?

No, it isn't and this is an essential point. Nobody can tell how things will actually happen. Intel's founders could not *know*, when they started their processor business that 40 years later there would be iPhones! However, they could sense and contribute to profound, lasting changes and create products with enormous potential, which could be developed, adapted and integrated into a countless number of systems. But they could not know. Today's technologies were almost unthinkable at the time, as well as the proportions that these technologies would take.

So, how can a company increase the chances of creating a revolutionary product without knowing the future?

By implementing a constant, efficient process that will allow to develop products within short deadlines, based on the actual needs of the market. This is all very down-to-earth! The aim is to generate ideas, collect them, sort them and make them happen as efficiently as possible. Apple or Google launch only 20% of the products they develop. Their archives are full of buried products! This is the culture of innovation. It is not about explaining that this or that product may change your life, but learning to accept and manage the risks, trying something new, observing, moving forward. Within a company, especially when business is going well, the unknown is perceived as a threat. What I am trying to make my audience understand is that the unknown must be regarded as something exciting.

You often describe the culture of innovation within a company as an "ecosystem", yet another reference to nature. Can you explain this concept?

It is about building up and orienting all the in-house conditions for innovation to thrive. Talking to all the staff about what is going on in the world. Which are the up-and-coming technologies? How to change our way of working so that an idea can be launched faster on the market? How to identify within the company the competencies that will help to select the most pertinent ideas, to present them to the customers in the most complete way? Innovating means managing both sides of the funnel to move from 10,000 ideas to a product. It involves organizing one side of the funnel to get always more proposals, talents, means and the other side so that the product may have an impact. In order to make this system work, it is also necessary to develop closer relationships with our partners, customers, the media, intellectuals, influencers. To create a multifaceted, dynamic structure to shift from a market notion to a whole ecosystem.

You say that in order to innovate, we need to "protect the future from the past" and not the contrary. Still, can we protect anything from the past, without giving up on innovation?

This is the paradox. Companies often forget about their own DNA, this genetic code which made them become what they are today. Therefore, they should rediscover it, and awaken the culture of innovation. The founder of a company like LEMO innovated 70 years ago, spending days and nights in his kitchen building connectors! Today 1600 people should feel responsible for inventing the future, managing the risk factor, but not letting it become predominant. The further we go ahead, the more important it is in a way to return to the foundations. All human organizations can only exist as long as they have a role in society. The danger starts when we become self-referential which is now the case in certain parts of the world. When the main priority of a company becomes not leaving the comfort zone, it is the beginning of the end. This end may last quite a while, but this is how it starts. Only if you question yourself consistently can the success story continue. |

"WE NEED
TO "PROTECT
THE FUTURE
FROM
THE PAST"

PROMOTING A CULTURE OF INNOVATION

IN ORDER TO MAINTAIN THEIR SENSE OF INNOVATION, COMPANIES HAVE TO TURN IT INTO A CULTURE AND THUS CREATE AN OPTIMAL ENVIRONMENT FOR TRANSFORMING AN IDEA INTO A SOLUTION. AT LEMO, THIS IS MATHIEU MENET'S MISSION.

Mathieu Menet, in a few words, how is your “innovation” plan set up?

It is based on three landmarks. First, monitoring technology with a system for filtering tendencies and analysing opportunities. Second, building an ecosystem to speed up the innovation process, rationalize and materialize ideas. Finally, we are working on a new network of experts, because the further we progress in innovation, the harder it is to have all the competencies in-house.

Mathieu Menet, innovation manager
and former fighter pilot ▼

Most certainly, one of the first things you had to explain was what the word “innovation” stood for ...

Exactly! The word is used in many different senses. At company level, the implementation of a culture of innovation may be associated with providing a ping-pong table or free food, doing brainstorming sessions all the time or writing plenty of ideas on post-its. But this is not at all what it means!

What is it then?

The objectives are quite down-to-earth. It is all about transforming an idea into a viable, feasible and attractive solution through an efficient and sustainable system. The process consists of analysing the situation, understanding the context, the inherent needs and uncertainties. Every uncertainty is then tested in order to transform it into knowledge. Using these new insights, we discover the directions where solutions for the future can be found. It is a repetitive, rigorous, concrete process that people rarely expect to see.

What is the biggest challenge of implementing such a process?

A new system is like a transplant. You must keep monitoring its evolution, otherwise it will be rejected. Innovation is a driving force that needs to become part of the everyday life of every single employee! We give everyone the opportunity to express themselves, whatever their position in the company, or their technical field. Everybody can influence the Group's future. The challenge is to make every employee understand that they actually do have power and to give them the means to use this power, so that the new culture can be adopted.

What is your core message to explain the importance of every single person in this new adventure?

We are living in a world of uncertainty, but full of opportunities. If we are not scared of this and work all together, we can benefit from all these opportunities. At LEMO, we want to continuously generate idea “bricks” which may later be used to build solutions that we cannot imagine today. Tools can be bought with money, processes can be aligned with the help of consultants. However, in order to go further, we need to develop our own culture, this is the real issue. LEMO has always been a big family, which is exactly what you need for innovation: a family that talks, exchanges ideas, helps one another, to which every single person can contribute. | Renzo Monti



WORKING ON THE HIGHWAY

By Brigitte Rebetez

Fully equipped with new technologies, Lifemark systems provide a safe working environment for roadway marking professionals. By creating these systems, Limntech has met the twin goals of saving lives and improving efficiency.

Working in the middle of traffic is a risky job. Only a few centimetres may separate you from death. Road marking highway workers know all about it. So does Douglas D. Dolinar, who, together with his wife Nancy, founded Guidemark Inc. in 1980. Their company has become a major player in the US road marking sector and like similar companies, several of their workers had been hit and seriously injured by passing traffic.

Douglas D. Dolinar refused to accept these accidents just because there didn't exist any better solutions for road marking than what had been used for decades.

"Our company has flourished thanks to the work of young people from the neighbourhood, explains the owner. These people are still with us, slightly older, but with solid expertise in the road marking industry! It is my duty to make their work safer."

In 2010, with a lot of creativity and persistence, Mr Dolinar started investigating GPS technology as the basis of a potential solution to protecting his workers. Two years later, he created Limntech Scientific with Professor William Haller from Lehigh University (Pennsylvania).

A number of important technical challenges had to be met. Designing an electronic control system robust enough to withstand heavy electrical interference was one of them. Functioning reliably in an operating temperature range of -6° to +46 °Celsius was another major challenge, but they managed to meet them both.

The first system produced by Limntech Scientific was the Lifemark 75, which enables the roadway striping team (a driver and an operator) to work without leaving the vehicle. Thanks to real time kinematics, GPS and laser line technology, Lifemark 75 can do pre-marking processes with a precision of +/- 2.5 cm. This pre-marking process provides an excellent base for painting the lines.

Even more innovative, Limntech Scientific has developed a solution specifically designed for road marking inspection and archival: Lifemark 200. This product provides a tool for governmental agencies and engineering firms for recording and locating road marks, as well as performing quality control tasks at highway traffic speeds. It combines real time kinematics, GPS and machine vision technologies.

This fall, Limntech Scientific will launch an even more innovative system. Lifemark 300 will enable to restripe existing markings without an operator. In fact, the vehicle driver will be able to do the job on his own. This will be the very first machine to be equipped with the patented PIXEL-Smart technology, based on machine imaging. The bulk of the work is automated: the system precisely positions the marking carriage, before dispensing paint or reflecting beads over the pre-existing markings.

While aiming at making road marking safer, Limntech Scientific made no concessions in terms of productivity, quite the contrary. Trucks equipped with these technologies allow the work to be completed much faster than traditional marking methods. According to Limntech Scientific, time saving could be as much as 75%, which means substantial cost saving. Mr Dolinar says: *"This is what we call combining the useful with the pleasant."*

ROAD
WORK
AHEAD



© Limntech

▲ CEO Doug Dolinar (left) and VP Engineering Bill Haller in front of a truck equipped with the Lifemark 75. Above the driver seat, the GPS antenna.

NEW MASTER GRIP ON FILM-MAKING

By Alexis Malalan



Designed for professional cinema and television filmmakers, the new Master Grip handgrips from the German company ARRI give a new dimension to shooting with a shoulder-held camera. Action scenes will be even more spectacular.

Camera technology has been constantly improving. However, electronic control system accessories have also gone through a spectacular evolution. For instance, stabilizing handgrips have existed for quite some time, but with the Master Grips, a decisive step has been taken. Before them, no handgrip offered the user as much in terms of ergonomics and functionalities.

Zoom, iris and focus settings, camera function control: with Master Grips, the operator can now have fingertip control over the camera lens, whilst holding and orienting the camera. Equipped with a touch screen, Master Grips provide for easy parameter configuration, according to the operator's preferences. In addition to these revolutionary functions, they are designed to withstand harsh environments. Their rugged design, their magnesium cast housing, as well as their excellent connectors (see below), make Master Grips ideal accessories for film, documentary or live shooting of major sporting events. The cameraman can walk, run and stay on the move for a long time with the camera on his shoulder. Whatever the weather conditions or the environment, he can shoot spectacular sequences without any discomfort or risk of losing control.

With the Amira ARRI has a camera system with large format sensor, specifically designed for documentary filming. Determined to provide cameramen with handgrips that are just as technologically advanced, with Master Grips, ARRI opens up a new array of opportunities to them. |



ARRI AND LEMO - A TOP LINE PARTNERSHIP

Founded in 1917 in Munich, ARRI celebrate their 100th anniversary. The trademark is a reference for cinema and TV professionals around the world, even in Hollywood. LEMO has been contributing to this success for a while.

LEMO connectors provide the quality that ARRI's cutting-edge products and the high expectations of their customers require. Today, practically all ARRI devices, from cameras to electrical interfaces and the brand new Master Grips, use LEMO connectors. For these handgrips, ARRI needed angular connectors, so LEMO developed Anglissimo, a solution that has now become part of the catalogue (see article on page 8).

- ◀ An Amira camera system with its two Master Grips
- ▲ On the top of the two grips, a touchscreen with fully configurable controls, status readout and multilingual display.

FROM NANOTECHNOLOGY TO *ASTRONOMY*

By Renzo Monti

It is impossible to observe outer space through a telescope with a deformed mirror. How can you ensure ultra-precision positioning and compensate for any deformation? This is the mission entrusted to Micromega Dynamics for a future telescope in Turkey.

Wind turbines, machine tools, marine industries, aeronautics, automobile or railways ... Micromega Dynamics feels at ease in applications where there is vibration. Specializing in passive and active vibration control systems, the Belgian company also develops solutions for structural surveillance and high precision mechanisms for scientific applications. These mechatronic devices are used in particular for measuring and actively controlling the vibrations and the form of large ground-based telescopes. They will equip the primary mirror of the future DAG

telescope, which will be inaugurated in 2020 in the Turkish mountains.

The stakes are high. The mirror measures 4 m in diameter, it is made of glass and the slightest deformation would obviously completely distort the data collected by astronomers. Consequently, its shape must remain constant within a few nanometres, after every movement and in all environmental conditions, such as gravity, wind, temperature variations - there will be a combination of all these where the telescope will

be installed at an altitude of over 3,000 m.

“There are two solutions to avoid deformation, explains Nicolas Loix, project manager at Micromega. The first one is to use a very thick mirror: it will be rigid and will not deform. However, this is very expensive and once it is cast, it needs to cool down for up to two years before it can be used! The second solution is to take a thinner mirror, which will deform, but we will compensate it. This was the solution selected for the DAG telescope.”

A rigid primary mirror would have been 50 cm thick and 40 tons. The selected mirror is 14 cm thick and weighs 4.5 tons, which is much less, but still enormous. Preventing its deformation under its own weight is a real challenge. *“It is the equivalent of making a man sit down on a sheet of paper, explains Nicolas Loix, while keeping the same flexibility of the paper!”*

In order to manage, Micromega installed 66 actuators on the rear side of the mirror, each of them generating a force of 100 kg with a precision of 30 gr. They dissipate less than 1.6 W (heat produced by electricity must also be minimized, since it causes deformation). Each actuator is comprised of a pneumatic power generator controlled by high-speed piezoelectric valves, an ultra-precision force transducer (0.03%) and control electronics capable of manoeuvring the whole combination and of

communicating with the telescope’s control programme. Since each actuator is factory calibrated, it can be entirely replaced, which implies full integration of the control electronics in the actuator.

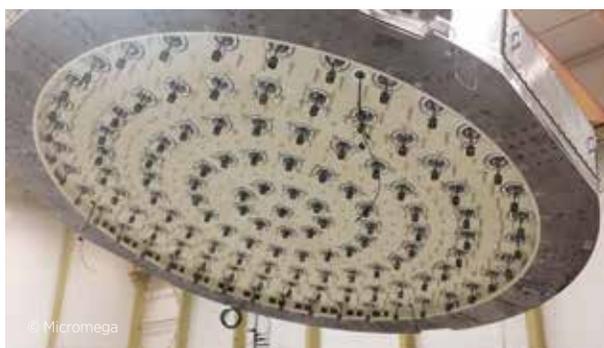
Micromega had already equipped telescopes in the past, but this project involved unprecedented constraints. *“For previous applications, we could use separate connectors for power supply, compressed air and communication, explains the project manager. In this case, electronics have to cope with 100% condensing humidity. To ensure full water-tightness, we had to reduce the number of entry points. This was possible thanks to LEMO’s fluidic connectors, which combine pneumatic and electric contacts, with simple assembly processes.”* |

EUROPEAN COOPERATION

The DAG telescope will capture its first beam of light in 2020. It will be the heart of the Erzurum observatory and, thanks to it, Turkey will at last be able to participate in complex outer space projects, such as observing exoplanets.

Turkish astronomers have been dreaming about such a telescope since 2000. *“They only had a small Russian telescope in Antalia, with operating instructions in Russian!”* explains Swiss astrophysicist Laurent Jolissaint. *This project will change it all !”* Laurent Jolissaint is the project manager for scientific instrumentation, a mission entrusted to the High School of Engineering and Management of the Canton of Vaud (Switzerland). The school is also in charge of the design management of adaptive optics and of the telescope.

The DAG project involves 6 main partners. The Belgian company AMOS (Advanced Mechanical and Optical Systems), the main contractor, is in charge of active optics, for which they have appointed Micromega Dynamics. The Italian engineering group EIE is in charge of mechanics. The German company Shott supplies the raw mirrors, which will be polished by LZOS (Lytkarino Optical Glass Factory) in Russia. The project owner is the Turkish science institute ATASAM (Atatürk University) in Erzurum, in partnership with ISIK University in Istanbul.

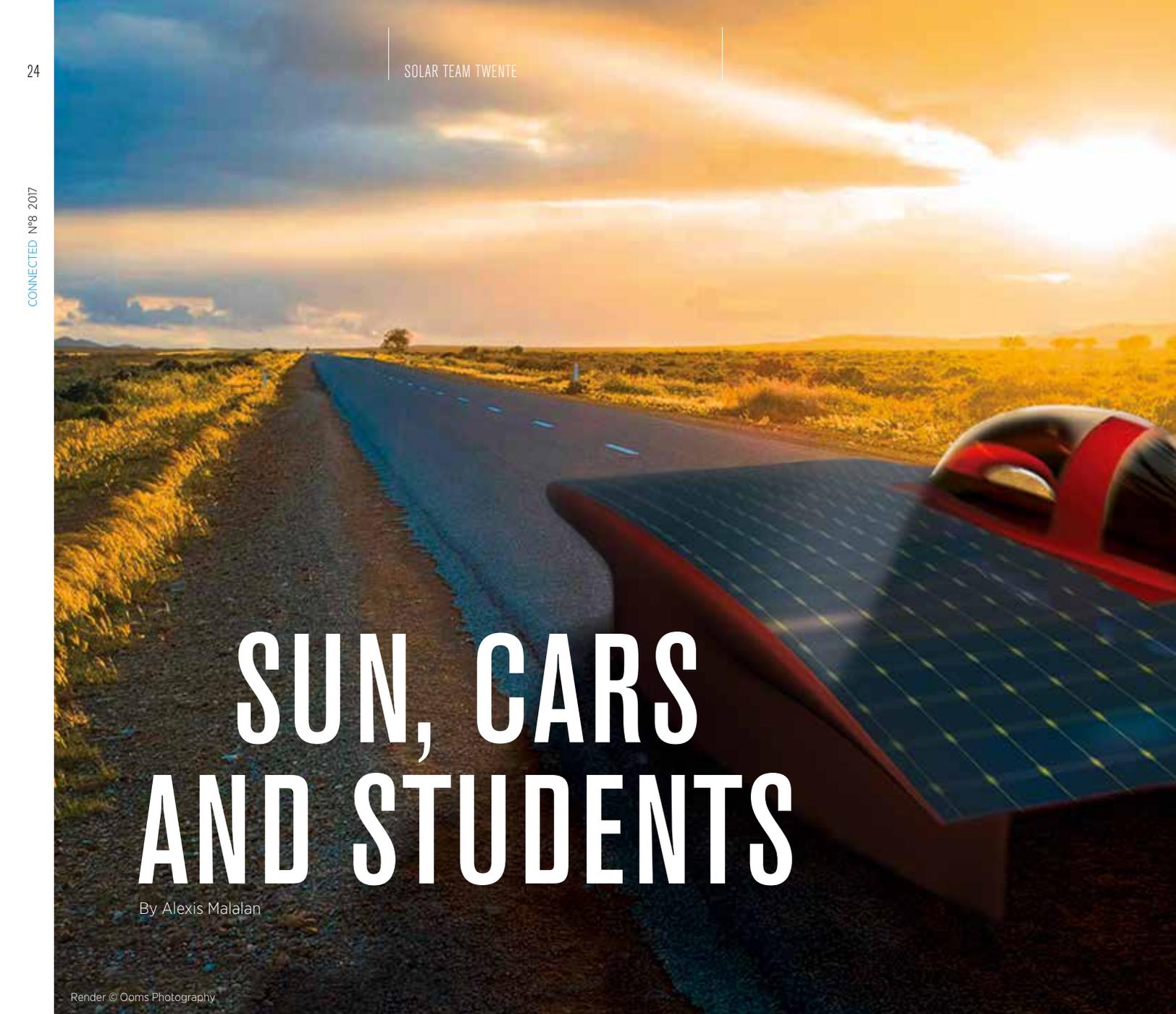


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- ▲ Top: Micromega actuators on the rear side of the telescope mirror (66 of these will be installed on the DAG telescope).
- Bottom: Actuator models to be installed on the rear side of the DAG telescope.

A solar car with a blue solar panel roof and a red and black cockpit is positioned on the right side of a long, straight asphalt road that stretches into the distance. The road is flanked by dry, yellowish grass. The sky is filled with dramatic, orange and yellow clouds, suggesting a sunset or sunrise. The overall scene is bathed in warm, golden light.

SUN, CARS AND STUDENTS

By Alexis Malalan

Render © Ooms Photography

The 2017 edition of the prestigious World Solar Challenge will be held in October. The Dutch team Solar Team Twente have been getting ready to win. Their quest is however in the far broader framework of promoting solar energy to be used in the automobile industry.



Few students would think or want to take a year-and-a-half break from their studies. However, when they are rewarded by an extraordinary experience, the choice is quickly made. So it happened for the young women and men of Solar Team Twente, whose objective is to go to Australia, the home of the Bridgestone World Solar Challenge in October.

Created in 1987, this unique competition is reserved exclusively for solar cars. From Darwin in the Northern territory to Adelaide, 3000 km to the South, it challenges about sixty race car teams split into three categories: the Adventure Class, attended by cars from previous years, the Cruiser Class, where practicality is the main criterion and finally the Challenger Class, focused on speed and energy efficiency.

Solar Team Twente runs in this last category, fairly successfully, since the team ranked second in 2015.

In fact, the Dutch team has been participating in the challenge for over ten years, but every year there are new challenges to take up. First, because the team is made up of new students every year and even if they are inspired by the seniors' experience, the rules change all the time, so they have to start almost from scratch.

For instance, in the 2017 edition, the surface of the solar panels authorized on the car has been changed from 6 to 4 m². Therefore, they need double ingenuity to stay competitive and to make the best use of the Australian sun.

Everything must be optimised. Every centimetre of the car roof is covered with silicon panels leaving only reduced space for the driver. Aerodynamics are controlled down to the smallest detail, to guarantee minimum resistance to wind. Composite materials are used, such as carbon fibre, in order to reduce weight to a maximum (only 230 kg including the driver). As for the engine, it is developed by Solar Team Twente and is extraordinarily efficient. With a power of 1 kW – the equivalent of a hairdryer! – it is capable of attaining an average speed of 90 km/h and a top speed of 130 km/h.

Such a project could never be a success without a cross-disciplinary team. It brings together design, connector and engine design specialists, together with the coaches, fund raisers and communication managers. Far beyond the technological challenges and the competition, Solar Team Twente also has a message to get across, which is that solar vehicles do have a future and real potential and that their research contributes to build a new form of mobility. |

▲ Solar Team Twente have just unveiled the design of their car that will compete in Australia.

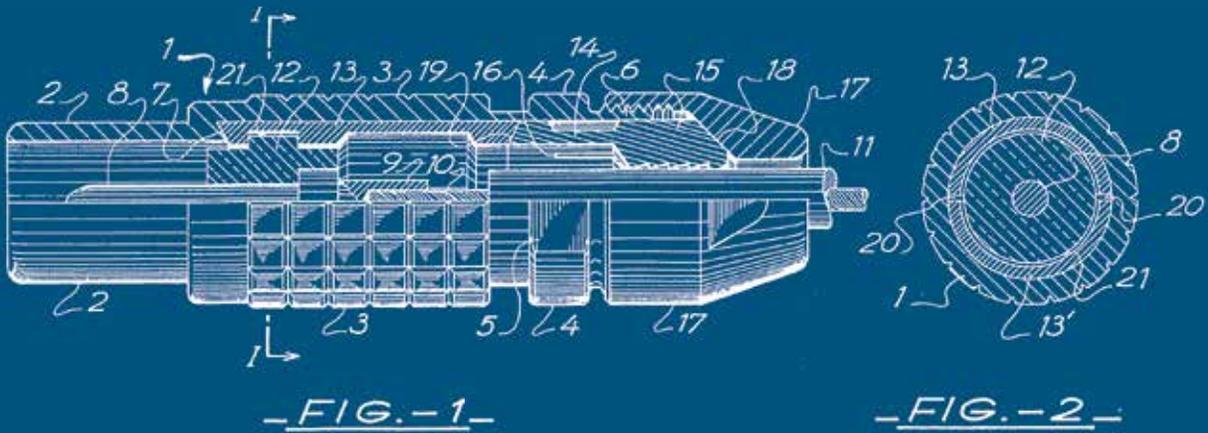


The current student team at work (here on the previous model during a race in Belgium last September) ▶

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1957 – AND LÉON MOUTTET CREATED THE PUSH-PULL

By Corine Fiechter



Exactly 60 years ago, the founder of LEMO invented a revolutionary latching system for the connector world: the Push-Pull. Let's go back in time to remember the creation and its inventor, with someone who used to work with Léon Mouttet.

Aerospace, medical, nuclear, audio-video, telecom, military or automobile industry: Push-Pull connectors have been adopted by all hi-tech applications. The adventure started 60 years ago at LEMO, or more precisely, in the mind of its highly creative founder Léon Mouttet.

The idea of this new system seems to have come to him for a personal reason. An engineer and keen photographer, he used to love to take photos especially of wild animals. At that time, camera flashes were mechanically triggered and at night, animals would trip on the wires, unplugging his photo installations. Considering the limitations of screw or bayonet systems used at the time, Léon Mouttet decided to develop an innovative latch system that would protect from any accidental disconnection, providing unprecedented safety. First, he observed car cigarette lighter sockets, before developing the famous 3-latch system which made LEMO a leader in the connector industry: the Push-Pull.

The new system quickly enticed customers. First the Swiss Post, then CERN (European Centre for Nuclear Research), before spreading across most of the industrial fields. After inventing it, Léon Mouttet never stopped refining the Push-Pull concept to further improve its performance.

"Mr Mouttet was a sort of a Gyro Gearloose engineering genius, who was at least 10 years ahead of his time, remembers Gérald Schmidt, assembly technician for over 40 years at LEMO. "He also had the idea, before everybody else, of injection moulded insulators instead of machining Teflon, as we used to do, when I started working for the company in the early seventies." One day, Léon Mouttet took Gérald Schmidt to the German part of Switzerland to show him the first injection machine. "It wasn't bigger than a sewing machine and you had to be a sort of an

alchemist to be able to mix all the different powders for using it! Later on, because of the Cold War, we also had to use radiation-proof materials, as well as PEEK."

At the time, production staff did not get much of an insight into what was happening in the offices. However, they were at the forefront of Léon Mouttet's new inventions. *"He used to make drawings all the time to share his thousand and one ideas with us. For instance, for modifying medical instruments for one of his surgeon friends. Or a deburring device that he invented using an old record-player!"*

Many customers would also come directly to the workshops, defying the thundering noise that the huge cam machines used to make, to ask for special products. For example, research engineers from the CERN. *"We designed the first watertight plugs and couplers for their bubble chamber and later contributed to the incredible adventure of the Large Hadron Collider, the largest particle accelerator in the world."*

Gérald Schmidt has now retired. He has left the world of Push-Pull, but the story goes on, as creating new innovative products is still part of LEMO's DNA. The company is now managed by the brilliant inventor's grandson, Alexandre Pesci. |

 **LEMO** 8 angles in 1 plug





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