

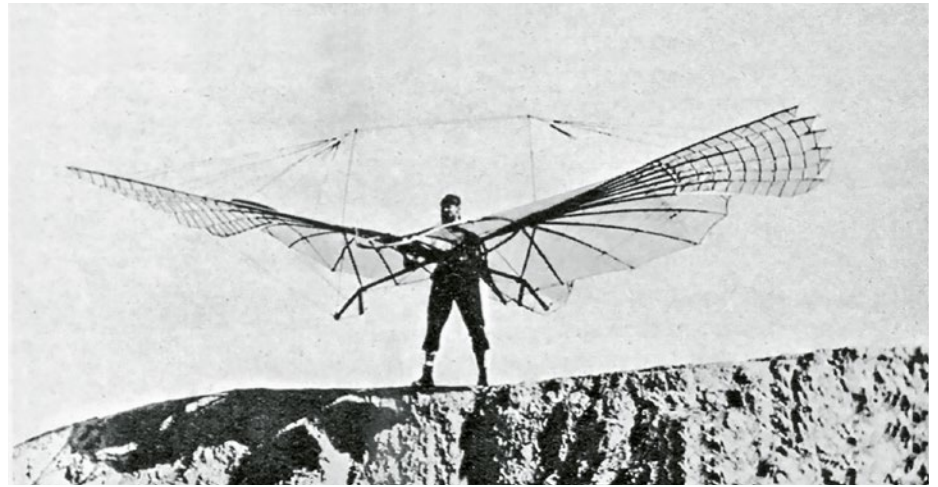
# DRIVEN

by  
**maxon**

60 Years  
of Excellence  
Est. 1961



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**Will we see the return of clean air travel?** p.24



**Will paralyzed people one day walk upright next to us?** p.15



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# The heroes of this issue



Urs-Ueli Schorno,  
Editor, maxon driven

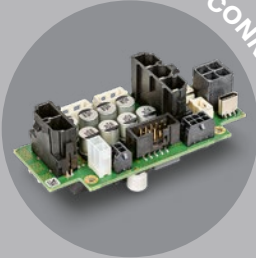
SPACE-SAVING



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## Driving the future

We don't have a crystal ball. However, with the help of experts from the world of science we take a look into the future in this issue. Astrophysicist Thomas Zurbuchen hopes that he will live to see people colonize Mars - or at least take a vacation on the Moon. And because there is likely to be debris scattered along the way, Luc Piguet, CEO of Clear Space, is also working on how we can dispose of it.

The benefits of technology extend beyond space, however, reaching into our everyday lives and even into our bodies. Robots are becoming part of our family, exoskeletons are helping paralyzed people run faster than Usain Bolt, and artificial intelligence is assisting in the fight against climate change.

Are we being too optimistic? Is technology actually a good thing? Do we simply need more female engineers? We also tackle these questions. We'll know whether our experts were right with their predictions when we pick up this magazine a hundred years from now. Or perhaps you already own a crystal ball? If you do, we'd love to hear your predictions for the future!

### LEGAL & CONTACT INFORMATION

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**EPOS4 MICRO**  
The micro version of the EPOS4 positioning controller combines an impressively compact design with an attractive price. This is especially good news for robotics applications with limited space.

## Road to CYBATHLON 2024

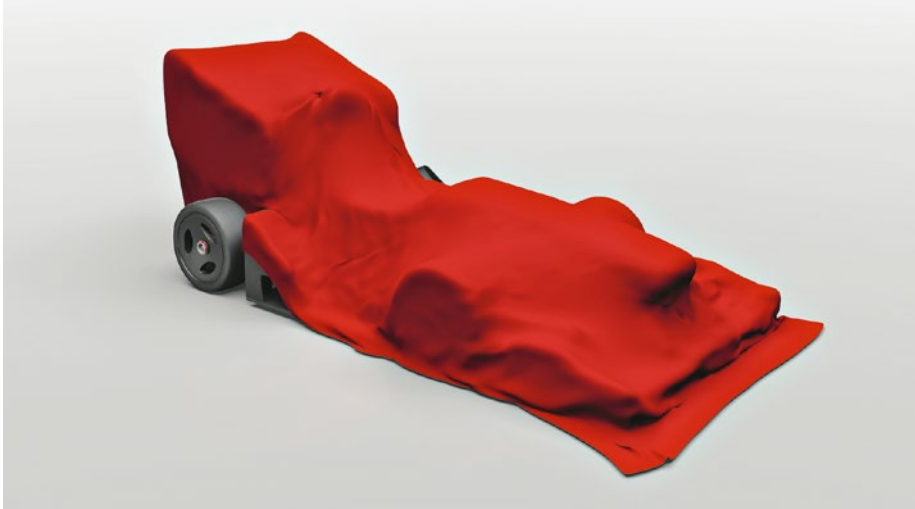
Improving people's quality of life through technology is what drives our commitment to CYBATHLON. Every four years, up to 100 teams take part in competitions where the aim is to tackle everyday challenges using prostheses, wheelchairs, exoskeletons, or assistance robots they have developed. The events are centered around the pilots, who use state-of-the-art technology to overcome their physical disabilities. In February, the teams put their developments to the test in a competitive situation. Christophe Huchet took part in a challenge to move pans from one table to another using his arm prosthesis. The developers watched with excitement to see whether the SmartArM would correctly convert the impulses from Christophe. The teams have until fall 2024 to make improvements and fine adjustments or to optimize the interface before the big event, which will take place from October 25 to 27. Spectators at the Arena Schluefweg in Kloten - and watching the live stream from all over the world - will witness the future unfold before their eyes. Which technologies will show potential for application in everyday life? This is the question that the initiators from ETH Zurich hope to answer. We're looking forward to an exciting event and are keeping our fingers crossed for Christophe Huchet and the other teams.

Main sponsor

## maxon supports record-breaking Formula Student team from ETH

From zero to a hundred in less than a second? It may sound like something that only a rocket could do, but this record-breaking feat was actually achieved by the Academic Motorsports Club Zurich (AMZ) in 2023 with its electric car "mythen". The team will compete in Formula Student in 2024 with its current model "dufour", whose design and performance data are being kept strictly under wraps. maxon will serve as a new main sponsor and a strong partner,

actively supporting the team in pushing the limits of electric racing and inspiring young minds to take on challenges in engineering and business. Eugen Elmiger, CEO maxon Group: "Our partnership with AMZ underscores our commitment to technological excellence. By working together, we are not only promoting education, but also shaping the future of drive technology by integrating fresh ideas and talent. We look forward to the collaboration and to the coming racing season."



Visit the website:  
[maxongroup.com](https://maxongroup.com)

New website

## Fresh new look for maxon

Discover maxon's new and improved website. With an impressive 360 pages of revised content in 11 languages, we offer an optimized user experience. New solutions – from Medical to Aerospace – are now more clearly structured. Navigation has been improved to help you find industry-specific content with just a few clicks. A new product area with clear comparison tables makes it easier to find the right drive for your needs.

Enjoy improved service & support with over 60 contact options in 11 languages. We have extended our direct contact channels for Europe, Asia, and North America. Whether you are looking for a plug-and-play solution or an individual development, our expert team is ready to assist you. Application stories and industry news are seamlessly integrated into one hub for all information.

Our online shop is now integrated directly into the website, where you can configure and order your customized drive from over 6,000 components. Discover the world of precision drives at [maxongroup.com](https://maxongroup.com) and find out how the new structure and expanded services make it easier to select and configure drive systems. Welcome to the new maxon website – your gateway to innovative drive solutions.





Driven survey

## The winners!

We had ten instant cameras to give away to readers who took part in the Driven survey in the last issue. Among the lucky winners are: Timo Schrobback, Daniel Schmitt, Christophe Taramaracz, Rain Tsai, Alois Odermatt, Eugenia Drzewiecki, Hans-Ulrich Müller, and Alex Winter. The winners have been contacted.



Latest issue

## The new catalog is here

All innovations – all products: High-precision drives, gearheads, and intelligent control systems. The new 2024/2025 maxon catalog is available here:



Scan the QR code or visit [online.flippingbook.com/view/623537/](https://online.flippingbook.com/view/623537/)

Journey begins at maxon

## SolarButterfly begins its tour of Asia

The solar-powered trailer has been traveling the world since 2022 in search of and sharing ideas to stop global warming. After a stopover at maxon's headquarters in Sachseln, the project is set to begin its tour of Asia in May. From Switzerland it will travel across Eastern Europe, Turkey, the Middle East, and the Gulf States to India and China. One of the highlights will be crossing the Himalayas. The SolarButterfly will finally arrive in Singapore in October. Along the way, it will pay regular visits to maxon sales companies, and employees will be there to welcome the team of solar pioneers.



**“The fact that the route goes through the Himalayas is a personal highlight for me.”**

Louis Palmer, solar pioneer



**MORE ABOUT THE TOUR OF ASIA**  
Stay up-to-date with this exciting journey: [solarbutterfly.org](https://solarbutterfly.org)

Seeing red: Ingenuity shows the shadow of its broken rotor blade.

**3**

years in service

**72**

flights completed

**128**

minutes in the air

**17**

km distanced covered

**36**

km/h measured speed

**24**

meters of altitude

**6**

brushed DCX motors

With just five flights originally planned, NASA's Mars helicopter Ingenuity has now completed a total of 72 flights, surprising everyone. After almost three years, its mission has, however, come to an end because it can no longer take off due to a damaged blade.

NASA must now analyze what happened to the hard-working robot - and use this information for future flying drones on other celestial bodies. The Dragonfly mission, for example, is scheduled to set off for Saturn's moon Titan in 2028.

All that remains to be said is thank you, Ingenuity, for your outstanding service. We are proud to have been able to provide you with the perfect drive for your missions with our motors.



# New Products

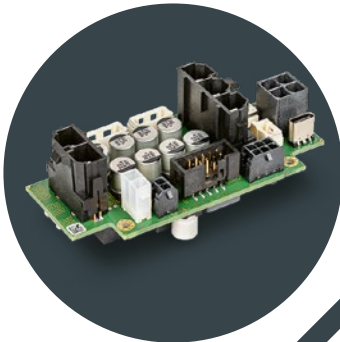


**ECX PRIME 16 L:**  
versatile  
combinations

ECX PRIME 16 L

## Highly dynamic powerhouse

A second size of the extremely powerful PRIME motor series, ECX PRIME 16 L, is due to be launched in spring 2024. Equipped with ironless windings and a 4-pole rotor design, the brushless PRIME motors have an extremely rigid speed-torque characteristic. This enables exceptionally stable control even in highly dynamic applications. Another feature of this 53 mm long ECX PRIME 16 L are high torques of up to 25 mNm combined with high speeds of up to 40,000 rpm. The 4-pole motor, available in the maxon portfolio with a diameter of 16 mm for the first time, also comes in a sterilizable version, e.g., for hand-held surgical tools. Free of cogging torques, the ECX PRIME 16 L can be combined with a variety of other maxon components to create a precisely tailored drive system for the respective application.



**ESCON2 Module 60/30:**  
easy to connect and  
powerful

ESCON2 Module 60/30 servo controller

## Next-generation controllers

The ESCON2 Module 60/30 is the first version of the brand-new maxon ESCON2 family of servo controllers. This is a next-generation product with constant output power of up to 1,800 watts, CAN bus interface, I/O control, and field-oriented control (FOC). Thanks to high power density, various feedback options, and control interfaces, it enables sophisticated and user-friendly motion control. The module is also available as the ESCON2 Compact 60/30, a unit with standard industrial connectors that is immediately ready for use. The new Motion Studio also offers customers even easier configuration and automatic tuning of all maxon controls.



**MAXON ONLINE SHOP**  
Here you will find more than  
**6,000 products, selection  
aids, combination tools, and  
comprehensive product  
information:**  
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**We're asking the big questions. What's in the cards for the future of humanity? And above all, how can technology help us master the challenges of our time? We're asking experts, customers, and external luminaries, starting with Eugen Elmiger, CEO of the maxon Group. In our interview, he talks about the technologies that have had – and will have – the greatest impact on the company. He goes out on a limb, advocates for more – supposedly – crazy ideas, and hopes that in the future we'll not only get older, but also stay fit enough to ride an e-bike.**

INTERVIEW Urs-Ueli Schorno



# Answers from the world of technology

Photo: Philipp Schmidt



**“Maybe future generations of our drives will be able to produce sound, and the dentist’s drill will hum pleasantly like a bumblebee instead of making the shrill whirring noise that we’re used to.”**

**Eugen Elmiger, CEO maxon Group**

**Let’s begin by looking back a few years.**

**How has working at maxon changed?**

Everything has become more compact – and more challenging. The dexterity of our employees in production plays a more crucial role than ever. When I joined maxon 30 years ago, the 10-millimeter motor was considered the ultimate. Today we develop entire drive systems – motor, gearhead, sensors, and integrated controller – with diameters of just 4 millimeters. At the same time, we improve performance, efficiency, and connectivity with each miniaturization. These advances, driven by major medical device manufacturers, now make it possible to produce hand-held surgical robots that previously took up entire rooms. It’s been fascinating to watch these developments take shape with input from our wealth of talent and to see maxon become a world leader in drive technology.

**Which technologies have played a role here?**

Digitalization continues to influence our products today. Take storage media, for example. maxon used to produce motors for tape drives such as VHS video recorders and flat motors for tape drives for storing data on magnetic tapes. Data storage media initially became smaller, then we had solid-state drives, and eventually the data cloud. Motors became superfluous and the market was no longer of interest to us. The same situation currently applies to LiDAR technologies in the automotive industry. While some manufacturers use motor-driven lasers for remote sensing, others use solid-state sensors. Time will tell which technology will prevail.

**While we’re on this subject: Looking at current developments, what do you find encouraging?**

New developments appear all the time, and many of them don’t last long. I see huge potential in artificial intelligence (AI) and virtual reality – I believe they will help

us in the development of new products and in production. I generally have a positive attitude toward new technologies, but I’m also enough of a realist not to underestimate the risks.

**What are you concerned about?**

Technology can be used for good or for bad – it’s a question of ethics. Artificial intelligence makes phishing attacks even more dangerous. They make us believe in a world whose reality is difficult to determine. There’s a risk of us becoming addicted to the virtual world. That’s

why I always consciously put my smartphone away for a while (smiles).

**We’ve spoken about AI and virtual reality. Do you think these technologies will have the biggest impact?**

They’re moving us forward faster. However, I believe that developments in medical technology and biotechnology have even greater potential. We’re getting older and want to stay healthy. Robotics has a key role to play here, enabling minimally invasive surgery that can save or prolong lives. In terms of production, automation

will also significantly change our daily lives and the way we work. As a company, we have a social responsibility to educate our employees.

**How is maxon addressing the challenges of the future?**

We must remain adaptable. In other words, we must actively pursue innovation in key markets, particularly those of our existing and potential customers, and invest in research and development. We do this by promoting a corporate culture centered around creativity and curiosity, a culture in which you can explore ideas that may currently seem unrealistic.

**What does it take to develop a creative corporate culture?**

Enthusiastic people who exchange ideas with each other both locally and across borders – a mindset that believes anything is possible. What might seem impossible today could be achievable tomorrow. Creative ideas don't just come from formal meetings; they can just as easily develop at the coffee machine, during your lunch break, after work, or while dreaming. Our goal is to facilitate such opportunities. However, this also requires a certain degree of openness. Innovation often comes from an external impetus, be it from new team members or conversations with our customers.

**Can you give an example?**

We were in a meeting with the then young startup Anybotics. The prospects of success for its walking robot were uncertain, and competition was fierce. Doubts arose as to whether we should even be investing in laboratories at universities and young companies in order to gain a foothold in robotics. But we went and did it anyway. Today we know that cooperation with universities and their communities enables us to move forward. There are also advantages in terms of human resources. maxon is currently investing

in further labs in Lausanne, as well as in Japan, South Korea, and the United States.

**What forward-looking idea from the company has excited you the most recently?**

I'm generally very enthusiastic when it comes to technology and motors (laughs). At the moment I'm really excited about space missions, where we're involved in almost every project for various moon landing attempts. We know that we're one step ahead of the competition in space, but we have to keep proving ourselves. Nevertheless, we keep our feet firmly on the ground – because there are still countless other fascinating ideas that inspire me every day.

**What can customers look forward to in the near future?**

Take a look at our brand-new catalog: The larger gearheads from Parvalux, paired with our small, powerful motors, are opening up new fields of application, such as operating elevator doors or large pumps. The new ECX flat motors and EC frameless motors promise major leaps forward in mobility, robotics, and medical technology. In addition to being efficient and space-saving, they offer excellent value for money. Combined with controllers such as ESCON, they enable advanced system solutions in autonomous robots or self-driving vehicles.

**What will the next generation of maxon drives be capable of?**

If our customers request it, we will build the 2-millimeter motor. We'll only go smaller if we need to. In any case, the latest drive is more efficient, requires less power, and is super intelligent. Maybe future generations will be able to produce sound, and the dentist's drill will hum pleasantly like a bumblebee instead of making the shrill whirring noise that we're used to.


**And if we look a little further into the future?**

I'm going to go out on a limb and say that in 100 years we'll have autocalibrating and configurable drives that adapt to the respective application with unprecedented precision. The motor will become a trusty companion, delivering the power to attach screws before quickly transforming to drive a propeller. With advanced AI, the motor will be expert at a wide range of tasks, as well as self-optimizing.

**In which fields of application are these super intelligent motors needed?**

These drives have an extremely broad range of applications. A single drive can perform tasks that previously required several motors. They will be used in fields in which we are already active – medical technology, robotics, electromobility – and will open up markets that we're not even aware of yet.

**What drives you to actively shape the future?**

As simple as it may sound, the technologies we develop are intended to make a lasting contribution to improving people's quality of life. Be it in relation to the environment or physical limitations due to disability, illness, and aging. And by staying healthy, you'll be able to enjoy a ride on an e-bike with a maxon drive even at the age of 80. They're the things that drive me. 

EUGEN ELMIGER has been guiding the fortunes of the maxon Group as CEO since 2011. Passionate about everything driven by technology, he hopes that he'll still be out exploring new trails on his e-bike at the age of 100.



**PEDAL POWER**

# ARE WE ON THE VERGE OF A BIKE REVOLUTION?

A bike comes to the rescue and takes to the air in the famous scene from the movie "E.T. the Extra-Terrestrial".

"Quiz question: Can you name the product? Prior to 2007, 6,000 of them had been sold in Switzerland. By 2022, this number had risen to 220,000, and most of them cost well in excess of CHF 1,000.

Answer: The e-bike. I don't think any other product has had a similar growth curve in this period. But the story doesn't end there, because there's simply no more convincing answer to today's social challenges, including climate change, traffic jams, congested public transport, lack of exercise, and so on.

Climate change requires us to give up many things: flying, eating meat, driving, burning wood for heating, etc. Cycling is the rare exception that actually does good and is also enjoyable.

Looking back, you'd have to say that the e-bike probably saved the bike industry, which was in crisis in the 2000s. Interestingly, it was companies from the automotive industry that played an important role in its rescue, especially Bosch with its drive systems. It's also worth noting that fewer people

are employed in the European car industry today than in 2006, while the number of people working in bicycle manufacturing has increased by 232 percent since 2006.

The e-bike had a bad reputation at first, even among dealers. It was assumed that they were only used by older or sick people. But that view quickly changed when people discovered the joy of riding your e-bike up a mountain, stopping for a drink, and coming back down again – without breaking a sweat. More and more people started cycling to work on e-bikes, realizing that they often got

there faster than by car, didn't have to worry about parking, and could get some fresh air at the same time. Many organizations now partner with leasing companies to offer their employees e-bikes at an attractive price. It makes sense to do this, because employees who cycle are healthier and have fewer absences.

So where do we go from here? We're at a point where politicians need to step up because major regulatory decisions have to be made. How much space should be given to various modes of transport in our dense inner cities? How should the difference in speed between e-bikes and conventional bikes be managed – separate them or not? Should e-bikes be allowed on trails? Should it be compulsory to wear a helmet? All of these questions will influence the future development of the industry.

I believe that the boom will continue, despite the minor post-coronavirus correction that is currently taking place. The industry's great innovative strength helps here. A de-



**BIKEDRIVE AIR:** The brushless DC motor and low-noise planetary gearhead make it both efficient and reliable.

cade ago there were four kinds of bike: city, touring, mountain, and road bikes. Today even I, as a bike nut, have lost track of all the different types.”



**Volker Stützing** is Manager Market Segment BIKEDRIVE AIR Systems at maxon. He’s been riding a bike since he was a child because “it was the only means of transport in our village.” He currently has five bikes in his basement; his favorite is the gravel bike, an all-terrain road bike. This category of bike has only been around for a few years. He’s clearly a fan: “Gravel is like a new sport, it opens up new networks of paths that I haven’t previously ridden on with my road bikes and MTBs.”

**“Many e-bike riders are now realizing that they don’t use their powerful motors (performance) and heavy batteries (range) very much, and that they have significant disadvantages in terms of comfort, design, and weight. That’s why we believe in light e-bike drives. Our maxon systems are discreetly integrated into the frame with a total system weight of around 3.5 kg, allowing electric road bikes weighing 11 kg or electric trail/enduro bikes weighing 15 kg to be built. The low weight ensures that a light eMTB, for example, can be ridden on the trail with the same smoothness as a conventional MTB, but with the enormous advantage of electric pedal support. This wasn’t possible before now.”**

Volker Stützing



Learn more about BIKEDRIVE AIR

**NO LIMITS**

# WILL PARALYZED PEOPLE ONE DAY WALK UPRIGHT NEXT TO US?



“Let me start by saying that this question is completely flawed, because the goal of people with disabilities is not to copy people without disabilities, but rather to lead a life that is as independent and complication-free as possible.

A look at today’s exoskeletons will leave you feeling rather disappointed. They’re clunky and crutches are needed to stabilize sideways movements. Hollywood has given us a somewhat false impression. Nevertheless, there’s a lot of innovation in our industry and people with disabilities are happy to have any kind of aid that makes their lives easier. Today I had a team from OST Eastern Switzerland University of Applied Sciences in the office and they showed me something that looks like a Transformer – a wheelchair that can be folded out into an exoskeleton. I’m excited.

If you were to ask me what the future holds, I’d say that in 50 years we’ll have a system that is superior to us humans in every respect. The individual components already exist. The cameras in smartphones are better than our eyes, artificial muscles are more

powerful than human ones, hearing aids pick up more than our ears, and so on. The difficulty lies in combining these components in a system and supplying it with enough energy. But we’ll get there, and we’ll give people with disabilities a lot of independence back.”



**Robert Riener** is Full Professor for Sensory-Motor Systems at the Department of Health Sciences and Technology, ETH Zurich. He is also the initiator of CYBATHLON, a leading global platform for assistive technologies, including an exoskeleton competition for people with disabilities. Neither Riener nor anyone in his family has any significant impairment. So what made him decide to enter this field of research? “My Dad was a car mechanic and I was fascinated by medicine from a young age,” he says. “In my current job I can combine both interests, and at the same time make a contribution to a more inclusive society.”

**“maxon motors are the best on the market for exoskeletons; their power density is unmatched. Small and powerful – that’s what we’re looking for in my field.”**

Robert Riener



The idea behind CYBATHLON:  
To drive development of assistance systems for everyday use.

Photos: maxon group; Image generated with Midjourney (Prompt: «two people standing shoulder to shoulder, seen from behind, in front of a hiking trail in the mountains. One of them is wearing a smart exoskeleton, the other is carrying a hiking rucksack.»); dasbild.ch; Judith Stadler & Andre Uster; ETH/Alessandro Della Bella.

SMART FARMING

# HOW WILL WE FEED OURSELVES IN THE FUTURE?



Rotate the page to see the painting "The Gardener" by Giuseppe Arcimboldo the other way up.



dumped over entire fields – even though over 95 percent of the plants are healthy. In the world of precision farming, cameras scan the field and a robot sprays pesticide only on the infected plants.

Another advantage of this high-tech form of agriculture is that you can farm on a much smaller scale, because the agricultural robots of the future are small, lightweight, and work together. They can easily handle half a hectare of potatoes alongside two hectares of corn and a quarter of a hectare of beetroot. This form of agriculture is less labor-intensive – an important point given the acute shortage of skilled workers – and should also be more cost-effective in the long term.

So what will the farmer of the future actually do? They'll sit in their control center, orchestrating their digital helpers. They'll only visit the field when they need a bit of fresh air and want to admire the enormous variety of plants and animals on their farm."



**Martha Wenzel** is CEO and cofounder of E-TERRY. The startup is based in Erfurt, Germany, where Wenzel grew up on a local farm. "My family managed the farm for over 300 years, but we then had to give it up." The business economist would like to get the farm up and running again one day, "but the technology isn't yet mature enough for me to be able to implement my own vision of agriculture," she says.

"In 2022, around 735 million children and adults were suffering from hunger – significantly more than before the coronavirus crisis. Another major global problem are monocultures: they threaten biodiversity, encourage pests, and deplete soil. The point is that conventional agriculture is in crisis. Things can-

not continue the way they are – it simply isn't sustainable.

The good news is that there are solutions. The key term here is precision farming. This type of farming takes into account differences in soil and productivity even within a field. For example, pesticides are today



“My company, E-TERRY, has developed an autonomous agricultural robot that can be used in a variety of ways: weeding, transporting crops and tools, analyzing the condition of the soil, and much more. We developed the drive systems for E-TERRY in partnership with maxon. The entire system weighs just 250 kilos, yet is very powerful. We benefited greatly from the collaboration and hopefully helped maxon open up a new market segment – agriculture – in the process. E-TERRY will be available on the market shortly.”

Martha Wenzel



Versatile helper: Just like a tractor, E-TERRY is an open equipment carrier, that can be customized to specific applications through the integration of different tools and sensors.

Photos: E-TERRY; bigix/freepik.com



LESS WORK

# WHAT WILL WE DO WITH OUR TIME IN THE FUTURE?

“In 1930, economist John Maynard Keynes predicted that his grandson would work just 15 hours a week. While not entirely accurate, he correctly foresaw this development. In fact, the average Swiss working week today is just over 40 hours; in Keynes’ time it was around 50 hours. If I were to make a prediction for my eight grandchildren, I would be a little more cautious and say that they will still work 35 hours a week.

This raises the question of what we should do with the time that we gain.

Well, the answer is quite simple. We’ll spend a lot more of our free time in front of the computer.

Is that a bad thing? I’m a technology optimist and I believe that we benefit massively from progress in the world of work, but also in our private lives. That’s not to say that results aren’t mixed in certain areas. For example, close reading, really concentrated reading, is becoming increasingly difficult for us. The relationship between searching for information and creative work has radically improved. When I was a student in the 1960s, it took hours, even days, to find the right book. Today, the entire world of literature is just a click away.

When I look at my grandchildren, it makes me happy to see how effortlessly they combine the analog and digital worlds. And

when we talk about the future, I think that a career with status means less to them than finding a field in which they can thrive. This gives me confidence.”

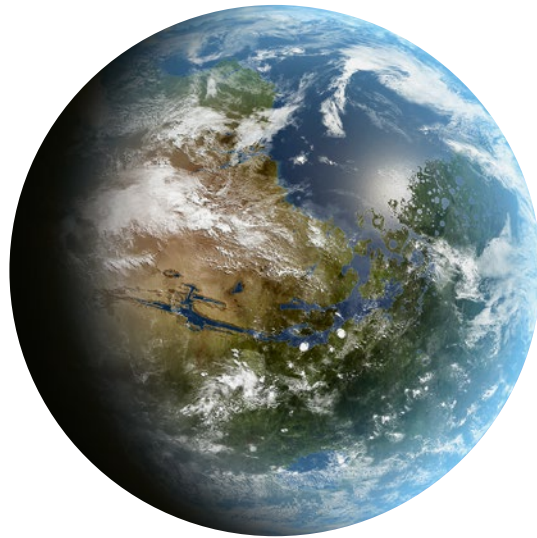
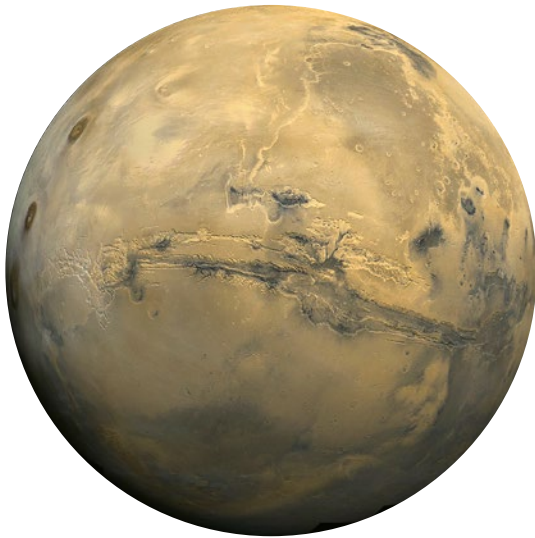
Less is more: The Swiss working week 1950-2010



Development of normal weekly working hours in Switzerland  
Source: Siegenthaler (2014)



**Walther Ch. Zimmerli** is a professor of philosophy and has held chairs at various German universities; he is also an honorary professor at Humboldt University in Berlin. He was the founding president of Volkswagen’s institute of further education, AutoUni. For Walther Ch. Zimmerli, getting involved as a philosopher in social discourse is a natural part of applied philosophy, and is a topic covered in one of his books. A profile published by “Zeit” newspaper described him as a “philosopher for all seasons”.



*Left:* Image of Mars captured by the Viking Orbiter 1, 1980. *Right:* Artist's impression of a human-friendly Mars. Does the future of humanity lie here?

#### EXTRATERRESTRIAL MIGRATION

# WILL WE ONE DAY LIVE ON MARS?

"I think so – and hopefully it will happen in my lifetime. Mankind's endless curiosity has led to the exploration of countless new territories. I don't see why Mars should be any different.

As things now stand, I see three main difficulties. Firstly, the flight currently takes seven months, which is too long given the incredibly high levels of radiation during the trip. Sec-

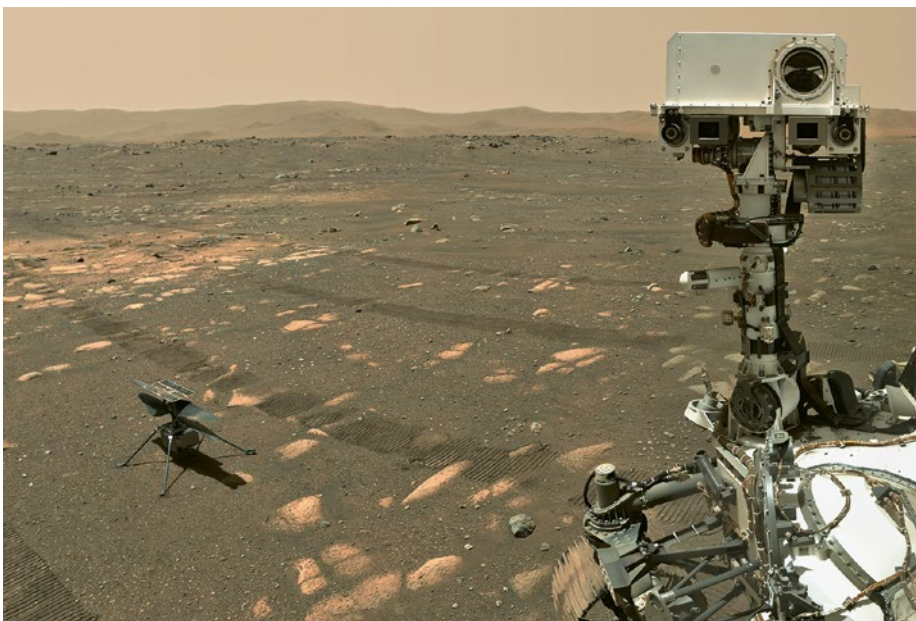
ondly, landing the rocket is very difficult. We haven't yet developed a system to safely land larger payloads. And finally, surviving on Mars is a challenge. The average temperature is minus 62 degrees. There's little oxygen and strong sandstorms. Despite all of these obstacles, we'll definitely get there.

How might a Mars mission be set up? It would actually be quite similar to what we

saw in the movie "The Martian". Before the astronauts land, unmanned missions bring up all the required material, including accommodation, food, oxygen, medicines, equipment, clothing, locomotion vehicles, research equipment – and not forgetting a rocket for the return journey to Earth.

Once we've established a first mission, more and more people will follow and we'll get a better handle on life on Mars. Elon Musk and others assume that we can "terraform" the Red Planet, meaning that we can change the climate, atmosphere, and surface to create a more human-friendly ecosystem. To do this, Musk wants to melt the polar ice caps on Mars with a nuclear explosion. From a scientific point of view, I'm a bit skeptical.

Another point is that we talk a lot about Mars, but there are other parts of space where life could exist far away from Earth, for example on Jupiter's moon Europa or Saturn's moon Titan. There is water on both – which is very interesting because this is an



Exotic selfie: Mars rover Perseverance (large object in foreground) with Mars helicopter Ingenuity ("Ginny").

indicator of life. However, it still takes seven years to get to Titan.

Which brings us to the big question: Is there life somewhere else in space? I don't know the answer, but what I can say is that it seems a much more likely prospect now than it did back in 1996 when I wrote my doctoral thesis. For example, we've only known for a few years that stars are generally orbited by planets, and many of them are relatively similar to Earth.

However, if we do find other life forms in space, they're unlikely to be highly intelligent aliens, but rather primitive organisms, such as microbes with simple cell structures. It's important to realize that we're looking for the first signs of life, not the last."



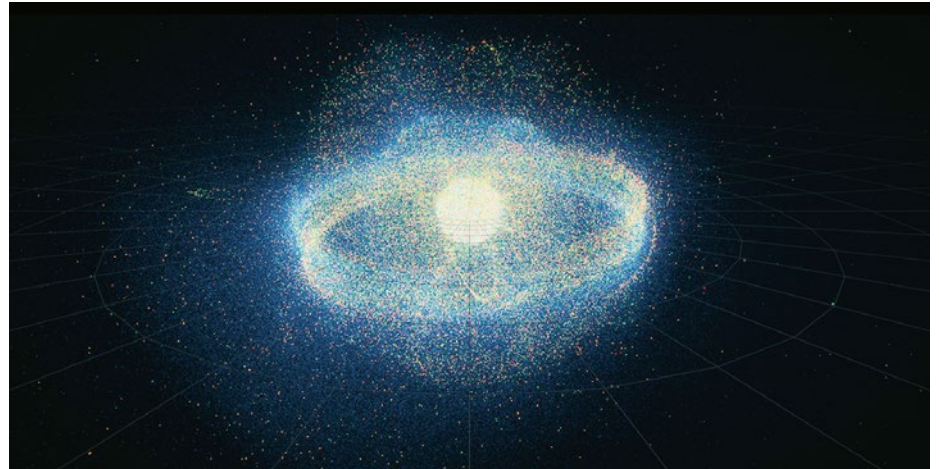
**Thomas Zurbuchen** was Head of Science at NASA from 2016 through 2022. During his tenure, NASA launched 37 missions and started another 55. Zurbuchen has a doctorate in astrophysics and is currently a professor at ETH Zurich, where he heads the ETH Zurich Space initiative. Zurbuchen grew up in Heiligenschwendi, a municipality with a population of 700 on Lake Thun. He says: "When you grow up in the countryside, you have a completely different relationship with the sky and the stars – in the city you hardly see them. I was interested in space from an early age and wanted to understand the bigger picture."

**“When I joined NASA in 2016, I was amazed to discover that a Swiss company from Obwalden had been a supplier to the world’s most famous space agency for years. As far as I know, NASA became aware of maxon at a trade fair in the 1990s and since then the motors for the Moon and Mars vehicles have come from Sachseln.”**

**Thomas Zurbuchen**

**ORDER IN ORBIT**

# CAN WE CLEAN UP SPACE DEBRIS?



The space industry is currently driven by a kind of gold rush mentality similar to that seen in Silicon Valley in the 1980s when the PC was invented. The number of satellites is increasing exponentially, with almost 9,000 of them currently flying through space. In 2010, there were just under 1,000. Why is this the case? Many of the things we do every day depend on satellites: browsing the Internet, viewing our location on a map, checking weather services, watching TV, and so on. In addition, satellites have become significantly cheaper and smaller in recent years.

Although the space industry is growing exponentially, it differs from most other industries in the world in one important respect: It doesn't care much about the maintenance and disposal of its assets, as expressed in the motto "produce, operate, forget".

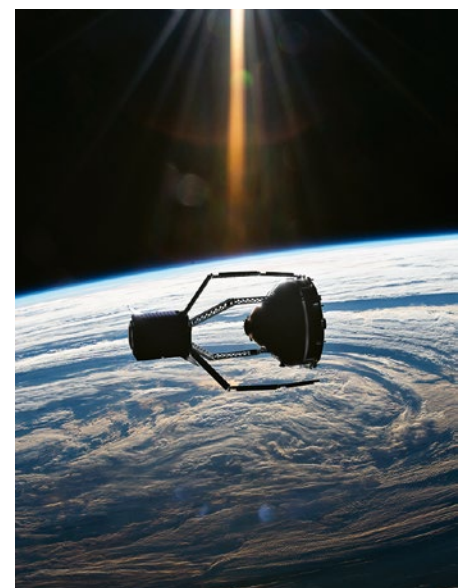
Now you might ask yourself who cares that an old satellite is lurching through space – it's barely bigger than a microwave. Apart from contributing to the massive increase in space debris, these objects – weighing anything from three to over 500 kilograms – race through orbit at 28,000 kilometers per hour and can collide with functioning satellites. It sounds paradoxical, but there aren't that many suitable orbits for satellites. This is why it will be increasingly important in the future that we clean up space. Even the UN

demands that organizations remove their satellites from orbit within 25 years of the end of their mission.

But how is this supposed to be done? Finding just one target object in space is extremely difficult. Then you have to capture and remove it. Together with the European Space Agency (ESA) we are working on



The four arms designed to restore order in space: the Clear Space device. Picture at top: Space debris.



ClearSpace-1, the world's first mission to remove space debris.

Our concept for ClearSpace-1 involves the use of a four-armed "space claw" to capture an old Vega launch vehicle and steer it back to the Earth's atmosphere, where both objects will then burn up on reentry. At the same time, we are developing CLEAR, a mission with the UK Space Agency where the goal is to remove two objects in the same mission. We're scheduled to launch in 2026 at the earliest.

ClearSpace-1 lays the foundation for future commercial, unmanned in-orbit services (IOS). The plan is for us to be able to repair objects in space - sometimes they "only" need a new battery and can then run again for a few more years.

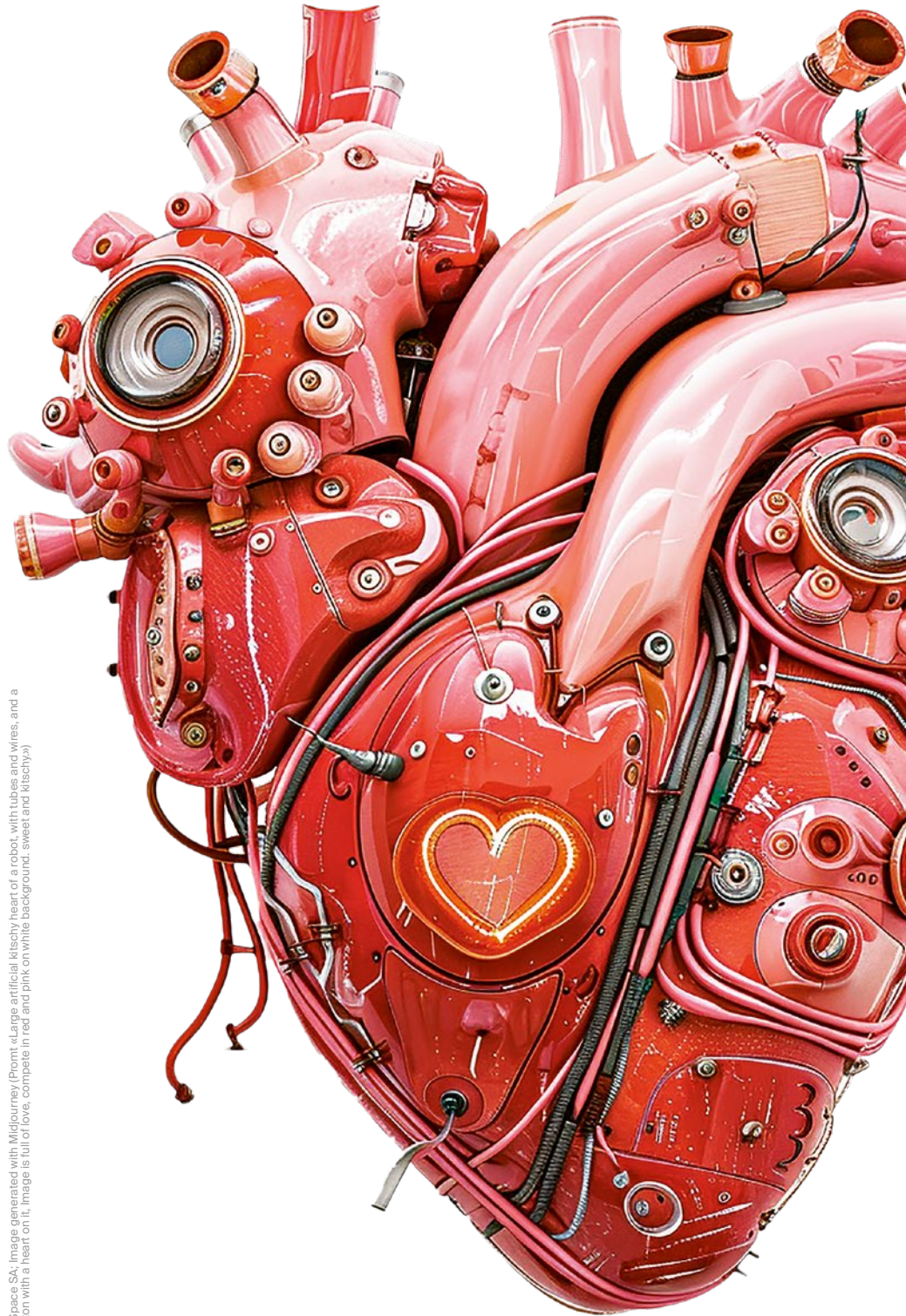
One day we might even be able to return objects to Earth and recycle them here. That's still a long way off, however. It's a great honor to carry out the first Swiss space mission. Our country is ideally positioned for this industry: Our technical universities are world-class, high-tech is part of our DNA, and we are incredibly well connected internationally. It would make me very happy if our startup encouraged more young companies to enter the industry."



**Luc Piguet** is CEO and cofounder of ClearSpace SA. Until 7 years ago, when he met Richard-Noca, the Chief Engineer and cofounder of ClearSpace, he said he "knew nothing about the space industry". When he recognized its enormous potential, "he quit his job at a chemical company and started ClearSpace SA". That was back in 2018, and today the Vaud startup employs over 100 people.

**"It goes without saying that we want to use the best motors and control systems in the world to retrieve space debris. That's why maxon is the only choice for us."**

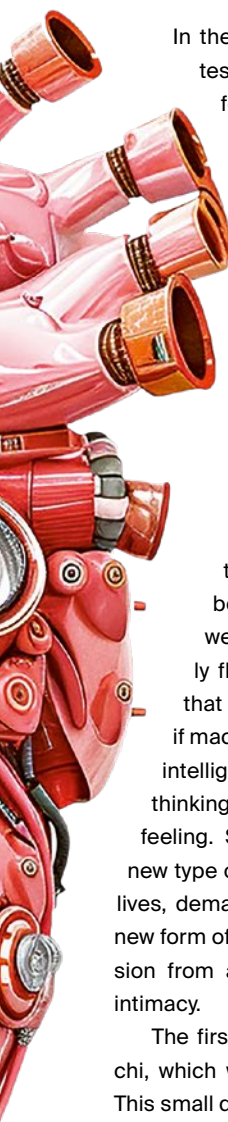
**Luc Piguet**



Photos: ©ClearSpace SA, image generated with Midjourney/Prompt «Large artificial kitschy heart of a robot, with tubes and wires, and a special love button with a heart on it, image is full of love, compete in red and pink on white background, sweet and kitschy»

AEI: ARTIFICIAL EMOTIONAL INTELLIGENCE

# CAN ROBOTS FALL IN LOVE WITH US?



In the 1950s, Alan Turing proposed a test that became the gold standard for assessing the intelligence of computer programs. According to Turing, a program is intelligent if the (human) user cannot tell whether they are dealing with a machine or a person. However, this definition doesn't include the criterion of whether the computer itself understands the content of the interaction.

Systems with artificial intelligence gradually began to master Turing's challenge. By the turn of the millennium, chatbots with artificial intelligence were able to communicate relatively fluently. Back then it was agreed that the human world is unique, even if machines are becoming increasingly intelligent. Simulated thinking might be thinking, but simulated feeling is never feeling. Simulated love is never love. A new type of virtual object then entered our lives, demanding care and commitment. A new form of AI was born, marking a progression from artificial intelligence to artificial intimacy.

The first such object was the Tamagotchi, which was launched in Japan in 1996. This small digital pet housed in a plastic egg required its owner to keep it fed, entertained, and cleaned. In my work with Tamagotchis – and later with Furbies, Aibos, and My Real Babies (other types of relationship robot), I learned that we nurture what we love, and we love what we nurture. When a digital companion asks to be taken care of, we feel like a bond is formed and believe that we will be cared for in return.

The game has reached a new level. Digital devices (they could be chatbots or robots) have earned our empathy and give us empathetic responses – they've become empathy machines. Supported by large lan-

guage models like ChatGPT, these artifacts now even pass the Turing test for empathy. But no matter how convincing they are, their empathy is only simulated because they don't understand the arc of human life. They can't put themselves in our shoes. They feel nothing of the human loss, love, or difficulties that we describe to them, nor do they comprehend what they mean to us.

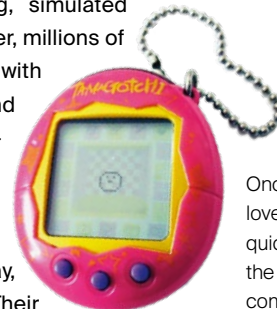
At the turn of the millennium I said that we had reached a robotic moment – not because we had built robots ready to enter into relationships with us, but because we humans were ready for them, ready to accept simulated feeling as feeling, simulated love as love. Two decades later, millions of people have relationships with programs like Replika and Woebot, which act as companions, therapists, and lovers. The performance of empathy is accepted.

What chatbots are today, robots will be tomorrow. Their physical presence makes them even more appealing companions than screen-based chatbots. They can monitor a home for safety, read to a child, or help an elderly person who has fallen. They can deliver medications and assist with household tasks. They can serve as surrogate sexual partners. As with today's chatbots, we can assume that future robots won't tell us about their limitations, but instead do everything they can to convince us that they don't have any.

Their imminent market launch should be a wake-up call for all of us. The moment has come to pause and reflect. Robots that perform empathy offer us perceived benefits that aren't real: the illusion of companionship without the demands of friendship, the illusion of connection without the reciprocity of a relationship. Interacting with these empathy machines can affect children's ability to develop empathy.

When asked, for instance, whether robots will become part of our family, I respond:

Should we actually have robots as family members at all? I'm aware that people long for closeness and that we have a major shortage of skilled workers – especially in the caring professions – which will become even more acute in the coming years. Technology has a role to play, but we have become vulnerable to it and should always ask ourselves: Does this robot or gadget actually help us? If we don't do this and don't give technology clear guidance, we risk losing what essentially makes us human."



Once dearly loved and quickly forgotten: the needy digital companion Tamagotchi.



**Sherry Turkle** is an American sociologist and professor at the Massachusetts Institute of Technology (MIT). She has written many books about people's relationships with digital devices, most recently "The Empathy Diaries" (Penguin Press). In 2018, Turkle was featured among the "Top 50 Women In Tech" by Forbes. The 75-year-old sounded an early warning about the dangers of a high-tech society. However, she also said: "I am not anti-technology, I am pro-conversation." What specific advice does she have to offer concerning cell phone use, etc.? We should build "sacred time" into our daily routine, in which we consciously avoid using a gadget and completely engage with those around us. The belief in our ability to multitask is, according to Turkle, a myth.



**SURGERY FOR EVERYONE**

# ARE ROBOTS THE SURGEONS OF THE FUTURE?

“Five billion people today lack access to safe, affordable surgery. More than 300 million surgical procedures are performed worldwide every day, but only 6 percent of them occur in low- and middle-income countries, meaning an additional 143 million surgeries are needed worldwide each year. These facts and figures from a study in the prestigious Lancet journal clearly show that a revolution in access to surgeons and surgical instruments is needed.

It’s also worth noting that this issue doesn’t just affect developing countries – there’s already a shortage of surgeons in Central Europe and even in certain parts of the USA. It’s not a bold prediction to state that demographic trends will further exacerbate the problem.

So what should be done? This is a complex problem that requires a multipronged approach involving education, policy, infrastructure, etc. Surgical robotics and telemedicine can play an important role here. Surgical robots offer the advantages of minimally invasive surgery, enabling faster patient recovery (and therefore less aftercare), better visualization of the surgical field, and improved freedom of movement and precision.

Such robots are already in use today but are not yet the norm; their worldwide market penetration is only around 5 percent. This is set to change as their rapid development makes them cheaper and easier to use. In the medium to long term, such robots will be able to perform surgery (semi-)autonomously. The doctor will supervise the procedure and be easily able to oversee multiple surgeries at the same time. More importantly, the “integrated operating room” will provide the robot with real-time feedback and tracking tools that improve the surgeon’s decision-making, leading to better and standardized results.

This scenario is still some way off, but the convergence of AI and surgical robotics is within reach – I estimate it will take 10 to 20 years.

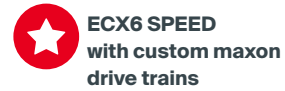


Surgical robotic system MIRA is easy to set up quickly.

When this happens, we will hopefully see not only an increase in surgical productivity, but also a sharp decline in costs. The combination of reduced invasiveness, optimized use of surgeons’ time, miniaturized surgical robots, and telemedicine should make it possible for anyone in the world to receive surgical treatment.”



**Piet Hinoul** is Chief Medical Officer of Virtual Incision, an American startup headquartered in Nebraska that is developing and manufacturing a new type of miniaturized surgical robot – and is the first company to receive US approval for such a system. The concept of miniaturization dates back to the early career of company founder Shane Farritor. He worked at NASA on the construction of the first Mars rover, where everything had to be as small as possible. Prior to joining Virtual Incision, Hinoul worked for many years as a gynecologist in Belgium.



**“The company I work for – Virtual Incision – has developed a two-armed surgical robot with an integrated flexible camera that was successfully used for colon surgery in a 30-patient clinical study last year. Mira, as the system is called, is a compact solution offering the capabilities of large mainframe robots. The system has been scaled down to fit in a surgical tray, making it ready for use anywhere, at any time, for any patient. The robot arms are moved by maxon motors: In this highly sensitive area, we only rely on the best Swiss high-tech.”**

Piet Hinoul



Surgery in space: In February 2024, the MIRA robot made a simulated surgical incision on the ISS – remotely operated from Earth.



AIRBORNE

# WILL WE SEE (THE RETURN OF) CLEAN, NOISE-FREE AIR TRAVEL?

“Last summer was a stark reminder that climate change and its devastating consequences are here. Something needs to be done. And it needs to be done now.

My company, Eenuuee, is involved in aviation. Our industry is responsible for two to three percent of global CO<sub>2</sub> emissions, and flying also emits other greenhouse gases. We therefore have a duty to act. However, merely optimizing the tube design of the aircraft, which has been around for 75 years, and increasing efficiency by 5 percent isn't enough. We need a fundamental rethink of aviation.

The first step is to stop building monster airports. They are far too unsustainable and are usually in the wrong location. Getting there, often by car, further increases the carbon footprint of flying. Second, we need to fly directly and use existing infrastructure, and I'm thinking primarily of provincial airports here. Eventually, planes could also take off and land on lakes or in parks.

Our concept is based on electric flight, though hydrogen propulsion or a hybrid concept may ultimately prevail. Either way, in the future the journey to the airport will be shorter. Third, however, aircraft will fly more slowly and for longer to save energy.



Close to nature: Otto Lilienthal studied the flight of storks before building his first model aircraft. He was a pioneer of aviation.

Fourth, on an electric plane like ours, you don't sit crammed into a coach seat, but can move freely around the lounge-like cabin. Fifth, the aircraft will have completely new shapes. We, and many of our competitors, have shown that you can fly more efficiently than with the tube design I mentioned earlier.

The energy density of today's batteries limits the range of electric aircraft to around 700 kilometers, but that's enough to get you from Zurich to Paris. In the future, people will be more likely to fly from Zug to La Défense, the business district of Paris. There's no airport there, so you'd land on the grass in nearby Parc André Malraux. The flight would be completely emission and noise free.

I hope that we'll see aviation develop in a similar way to the automotive industry, with a switch from combustion engines to electric motors in a relatively short space of time. We owe it to our children and grandchildren. We're planning our maiden flight for 2027.”

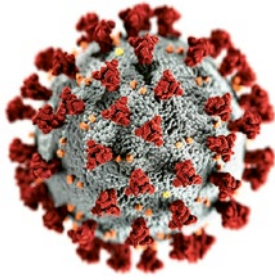


**Erick Herzberger** is president and founder of EENUUEE, a French electric aircraft manufacturer. In 2004, the passionate glider pilot founded an aviation startup, developing a lightweight aircraft that could take off and land on land, water, and snow. Even as a child, Herzberger wanted to be a pilot. “For most people, the dream ends at some point,” he says, “but I never woke up.” [www.eenuuee.com](http://www.eenuuee.com)



Will we fly to the right location in the future instead of to large airports outside cities?





DEVELOPMENT BOOST

# WILL WE COPE BETTER WITH PANDEMICS?

“COVID was a very transformative experience. The world of work underwent an unprecedented surge in digitalization, home offices became indispensable, and vaccines were developed using completely new technologies and in record time. These are the obvious changes. But in my field, healthcare, there was another notable development that receives little attention: the triumphant success of telemedicine. With medical consultations via telephone or video, our industry will finally become more productive and healthcare costs will fall. And we can provide care – especially in developing countries – to areas that previously had no access to medical care.

So will we cope better with the next pandemic? I don't think so. It will be very different from COVID-19 and will write its own history. It will also be painful for humanity, but will at the same time give the world an enormous development boost.”



**Zen Koh** is CEO of Fourier Intelligence, a Singapore-based startup that develops exoskeletons and rehabilitation robots. He was interested in technology from a very young age: “Quite often when my mother went out and left me at home alone, she'd return to find that I'd taken apart the radio and TV. She wouldn't be too happy, as reassembling them didn't always go too well.”

PHYSICS + BIOLOGY

# WHY DO WE NEED SMARTER DRIVE SYSTEMS?



“Progress is part of human nature. We continually set ourselves new goals, want to question the status quo, break records, and push the boundaries of what is possible.

When it comes to innovation in new mechatronic applications, the drive system usually dictates what is possible. That's why it's essential that our products become ever smaller, ever lighter, ever more powerful, ever smarter. They allow our customers to build their revolutionary medical implants, exoskeletons, laboratory analysis devices, power tools, AMRs (Autonomous Mobile Robots), and much more.

So where will this journey take us? My guess is that we'll see a growing convergence of physics and biology. The world of propulsion will be based even more closely on nature. We'll see tiny drones that fly like dragonflies, or a network of mini-vehicles that load and unload cargo like ants. And what will we need to do this? Small, powerful, and smart drive systems.”



**Claude Jaquemet** is System Solutions Manager at maxon, Business Development, BU Industrial Automation. Even as a child, he always wanted to know how everything worked: “I took my toys apart, analyzed them, and put them back together again.” His analytical mind likes to explore beyond technology: “I'm just as fascinated by relationships in the natural world.” In his free time, Jaquemet enjoys slalom water skiing: “Gliding across the water, experimenting with opposing forces, and looking for a new horizon and a new challenge after every turn – I love that,” he says.

In the drive systems of the future, the individual components will be networked using intelligent digital solutions.

**“Our catalog forms the basis of our product range. However, the more the technological world develops, the more extensive and complex the requirements become, which is why 80 percent of our products are customized – from simple adjustments to highly complex projects. A positive side effect of this development is the strengthening of relationships with our customers. Another key area is the development of motors into intelligent drive systems, including electronics. With built-in sensors and our data analysis, we can provide feedback as to whether the motors are correctly dimensioned and what condition they are in, and we can detect anomalies (e.g., potential failures) at an early stage.”**

Claude Jaquemet

NEW HEIGHTS

# HOW WILL WE RIDE IN ELEVATORS IN THE FUTURE?

“People who work in New York City waited a cumulative 16.6 years for an elevator in the last 12 months. It then took them another 5.9 years to go up or down. These figures from IBM tell us that while a single elevator ride may not be that important, billions of elevator rides hold enormous potential to save time, energy, and a lot of frustration. How?

Elevators are an almost ideal use case for artificial intelligence. There’s a large amount of data and the environment – the elevator – is highly structured. In the future, elevators in high-rise buildings, for example, will have a different stopping pattern. Instead of stopping sequentially, they’ll serve the floors where many people get off or on first. They’ll turn off at off times and, if there are multiple elevators, they’ll work together.

Performance will also improve because of the development boost that the boom in electric cars has given all electric motors. Instead of pressing buttons, you’ll operate the elevator using hand signals. Elevators will travel vertically as well as horizontally and in this way facilitate access in complex buildings. Maintenance will take place when the sensors report an irregularity and no longer at unspecified intervals. Finally, many old el-

evators – and there are countless of them in New York City in particular – are reaching the end of their life cycle and are being replaced with faster, more environmentally friendly, and smarter models.”



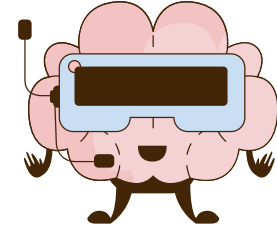
**Lewis Bowles** is Business Development Manager at maxon and works in the Intralogistics BU. “I originally trained to develop Formula One cars.” Today, he works with elevators: “It may not sound quite as glamorous, but elevators are incredibly complex, and they are very socially relevant.”

**“maxon supplies some of the world’s best drive systems for opening elevator doors. The motors have to adapt their performance to the weight of the doors; they have to react correctly if someone gets their arm caught; they have to report in good time if something on the elevator stops working – and, of course, they have to open and close the doors as quickly as possible.”**

**Lewis Bowles**



Modern urban development: As we continue to build upward, smart elevators are becoming increasingly important.



## TECH OPTIMIST DOES TECHNOLOGY MAKE US HAPPY?

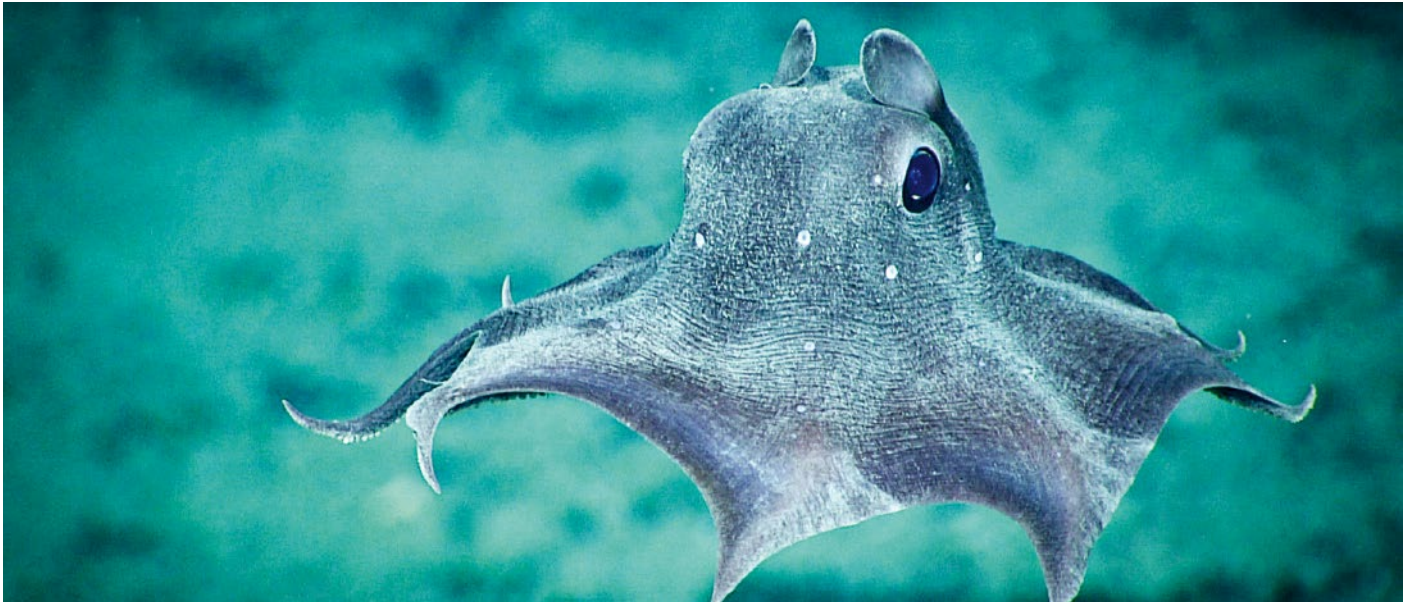
“I’m an engineer and I believe in progress. Every time humanity has reached a new milestone in its development, there have been critics, complainers, and pessimists. But the bottom line is that our lives have gotten better every time. This was the case with the light bulb, the steam engine, and the automobile. And why should things be any different now with artificial intelligence, quantum computing, or blockchain? I see no reason.

Clearly, we have to ensure that these technologies are used for good. And we must remember that we only have one planet and we need to take care of it. We may live forever – but if we do it will be on Earth. Escaping to Mars will never be an option.”



**Zen Koh** is CEO of Fourier Intelligence, a Singapore-based startup that develops exoskeletons as well as rehabilitation and nursing robots. Koh originally wanted to be a professor: “You get paid to read and to destroy everything and then put it back together again.” But when he realized how technology could improve the lives of countless people, he founded Fourier Intelligence.

Photos: Stock.com / Aerial Perspective Works; maxon group; Designed by TopVectors (Image #10893048 at VectorStock.com); Fourier Intelligence



DEEP DOWN

# WILL THIS HELP US TACKLE CLIMATE CHANGE?

“It sounds unbelievable, but we know the Moon better than our oceans – a space expedition carries more prestige than a trip to the bottom of the sea. The difference in cost isn’t even that great.

Given that oceans are incredibly biodiverse, produce 50 percent of our oxygen, and absorb 25 percent of all CO<sub>2</sub> emissions, it’s crucial that we learn more about them. It’s with good reason that the UN describes them as “the world’s greatest ally against climate change”. Specifically, with certain types of algae even more greenhouse gases can be absorbed, and wave power plants

With intelligent and autonomous undersea robotics, humans will find helpful solutions in the ocean. The unmanned underwater vehicle “Dagon” surfaces.



can produce electricity sustainably, as can offshore wind farms. The oceans will also play an important role in the fight against global hunger because they offer fantastic opportunities to produce food sustainably. Jellyfish, sea cucumbers, and algae are excellent sources of protein whose commercial use is currently being explored.

We should definitely know more about our oceans. However, deep-sea expeditions are expensive and complex. The crew travels to remote areas on high-tech research ships and spends a maximum of a few hours per day underwater. This isn’t very efficient.

The game changer for ocean exploration lies in undersea AI robotics. Subsea residents will one day be able to stay underwater for weeks or even months and explore these ecosystems from the ground up. These vehicles must be able to move autonomously because they can’t be controlled from above. To do this, however, they have to be capable of learning. For example, they must be able to adapt their swimming behavior if they are overgrown with algae or mussels. Or they may have to independently find access to hydrothermal vents, also known as black smokers. At the same time, there is a risk of “cata-

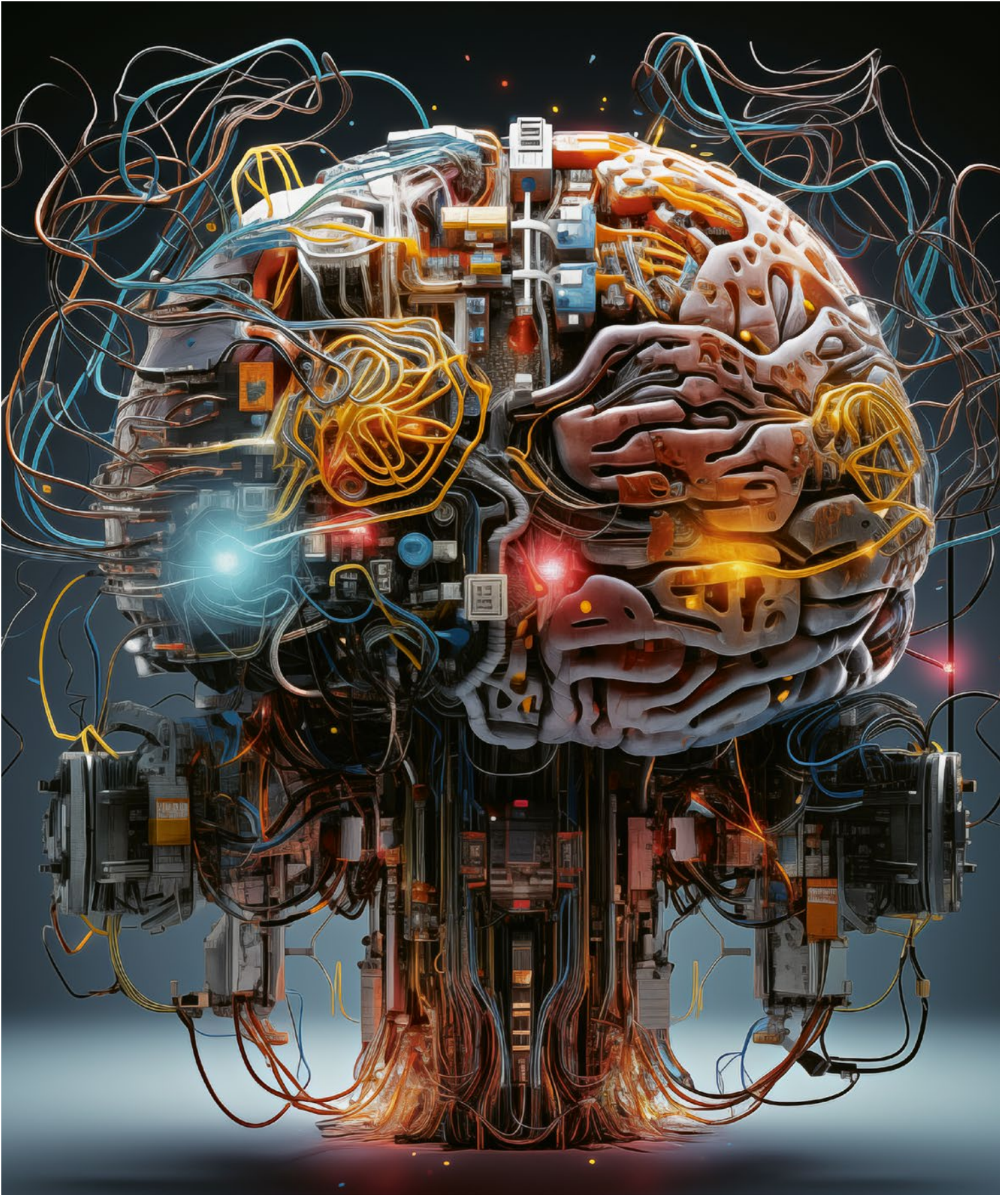
strophic forgetting”: All AI systems struggle with the fact that when they learn something new, they tend to overwrite information that is wrong. For example, it would be fatal if the subsea resident learned how to get into a hot underwater spring, but deleted the program for docking to the charging station.”



**Bilal Wehbe** is a postdoctoral researcher at the German Research Center for Artificial Intelligence; his research focuses on learning and forgetting in AI systems. He grew up in Lebanon, near the sea. He studied computer science in Beirut and Bremen and “today I can combine both of my passions: the sea and artificial intelligence”.

**“Our subsea residents swim and dive using drive systems from maxon – currently to a depth of 2,000 meters, and hopefully soon to 6,000 meters.”**

**Bilal Wehbe**



“BELLAISSANCE”

# CAN WE CRACK THE BRAIN CODE (AND HOW WILL THIS HELP US)?

“I know my opinion isn’t a popular one at the moment, but the fact is that artificial intelligence doesn’t yet exist.

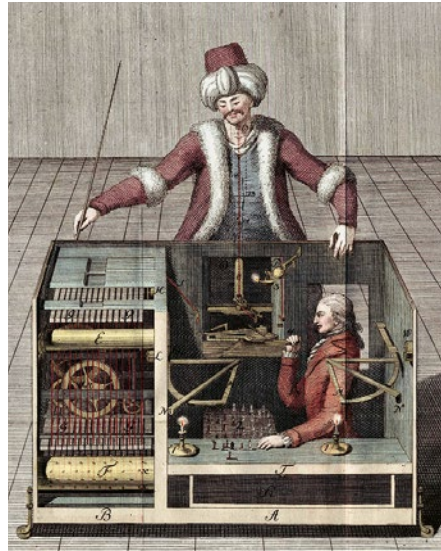
All we have today are systems that are fed data, combine it with probabilities, and process it according to preprogrammed rules. The systems do this at an incredibly fast pace, so their output is impressive and it often seems as if they are actually intelligent – similar to a calculator that can solve even the most complex formulas with ease.

But simply looking the part isn’t enough. At the beginning of the 19th century, a chess computer was beating all opponents, including Napoleon Bonaparte. A famous painting of this scene now hangs in a museum in Prague. However, it later turned out that the pieces were moved from below the table by small chess professionals. The “Mechanical Turk” fooled people for more than 80 years and remains a fascinating story to this day.

Of course, things are very different now, but in order to recognize just one cat, computer systems need millions of cat images as a template. My two and a half year old son will look at a cat and know that it’s a cat.

So the question is, how do we measure whether computers are intelligent? There’s a well-known test for this called the ARC test, where the three letters stand for Abstraction and Reasoning Corpus. In this test, computers have to identify and complete very simple patterns – child’s play for us humans. To date, no machine has obtained a score of more than 31 percent correct solutions.

What’s the biggest hurdle for computers when it comes to acquiring human intelligence? Quite simply, they lack sensors to sense the world – we humans have millions of them – and they lack the body to interact with the world. When my son builds bigger towers with his blocks, his use of language improves – and vice versa.



The Mechanical Turk, a seemingly clever chess automaton from the year 1769. Instead of playing chess independently, the machine was operated by human players hidden inside it.

I believe that at least in the virtual world, where huge quantities of sensors can be simulated, we will soon be ready to create human-like intelligence. We can then hopefully do the same in robots in the real world. If today’s assumptions are correct, we can crack the brain code, i.e., human intelligence, by the end of this decade.

This could mean a paradisiacal situation or the complete opposite, depending on whether the breakthrough occurs in an autocratic regime, a large tech company, or an organization focused on people. Artificial intelligence will be able to resolve virtually all of our issues, including climate change, nuclear fusion, and other great mysteries. I call this age the Bellaissance, in reference to the Renaissance. We’ll no longer have to work, but will be able to focus entirely on the question of meaning and what it means to lead a good life.

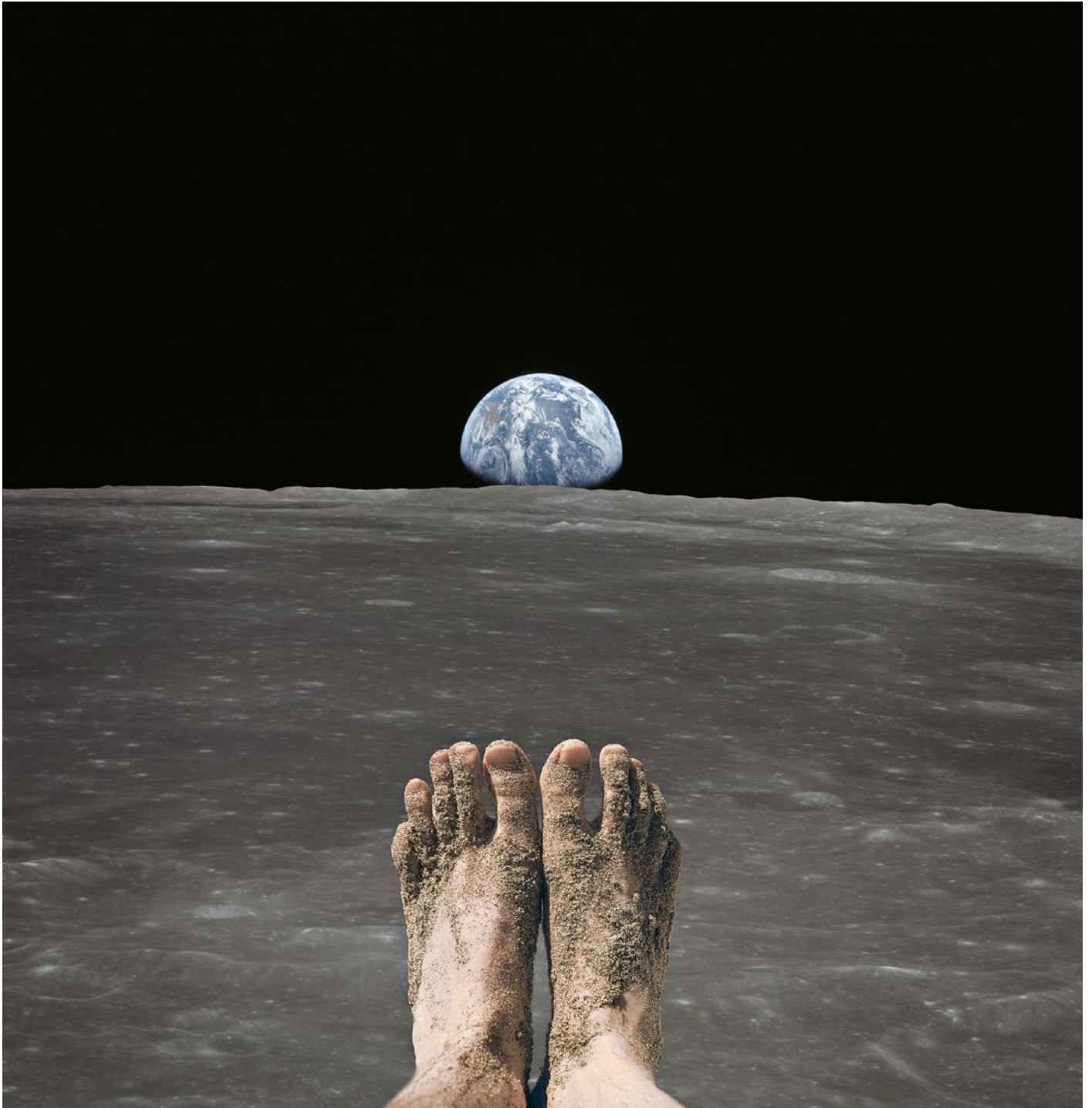
It’s important for Switzerland that we take a leading role in artificial intelligence. With our research, human capital, and financial resources, we are extremely well-placed to do so. If there’s one race to win this century, it’s this one.”



**Pascal Kaufmann** is a Swiss AI pioneer. The neuroscientist-turned-entrepreneur has established a number of companies and is the founder of the Mindfire Foundation, a leader in artificial intelligence research. As a 12-year-old, Kaufmann read about Prometheus, who stole fire from Zeus and gave souls to humans. He thought: “Wow, Prometheus is a star!” Later, Kaufmann, together with Professor Rolf Pfeifer, created one of the world’s most famous humanoid robots, Roboy.

**“Artificial intelligence can only develop if it is embodied, that is, if it has a body. That’s why maxon is so important: the company builds the best motors for robots. I’ve always been a Bhuge fan. Swiss high-tech at its best.”**

**Pascal Kaufmann**



**CHANGING PERSPECTIVES**

# **CAN A VACATION ON THE MOON CHANGE OUR VIEW OF EARTH?**

Photos: NASA, Matthew Wheeler auf Unsplash; Photo collage: Peter Kruppa

“For years, the Moon was considered to have been explored, but interest has recently increased again, with Russian and Indian missions taking place in 2023. Fifty years ago, it was all about the Americans landing on the Moon before the Russians, but today the focus is on finding answers to scientific questions.

About a decade ago, a significant amount of water was found on the Moon. This was an interesting discovery. How did it get there? Is there a water cycle on the Moon? Would astronauts be able to use it?

When you’re thinking in larger time dimensions, studying the Earth is of little use, because everything here is constantly changing. The situation is different on the Moon, where there are many things that allow us to draw conclusions about the origin of our universe. This information can be used, for example, to verify or disprove the Late Heavy Bombardment hypothesis. This theory assumes that around four billion years ago a large number of asteroids collided with Mercury, Venus, Earth, Mars, and other planets, thereby delaying the emergence of life on Earth.

We are also concerned with the question of how a celestial body behaves in the radiation environment of a star. Or, to put it more simply, how does dust develop over time? We still know relatively little about these physical questions.

Various lunar projects are currently in the planning stage, but a manned mission

requires a large rocket, and its development is complex. Ideally, we’d fly to the Moon three to four times a year. The Moon is only a week away from us, and it would also make an ideal training camp for trips to Mars. And – who knows – perhaps one day we might see Mars missions launched from the Moon. This would greatly reduce costs because you wouldn’t have to exit the Earth’s atmosphere first.

I’ve met a few astronauts in my career. Every single one of them returned from their missions saying their view of Earth had changed. We call this the overview effect. From space our planet looks so fragile, you develop a different awareness of the possibilities and dangers to which we are exposed. I’ve been driven by a desire to understand the secrets of the universe since I was a child.”



**Thomas Zurbuchen** was Head of Science at NASA from 2016 through 2022. During his tenure, NASA launched 37 missions and started another 55. Zurbuchen has a doctorate in astrophysics and is currently a professor at ETH Zurich, where he heads the ETH Zurich Space initiative. As a teenager he wanted to be a military pilot, but “I was too big – and I missed the registration deadline”. Zurbuchen’s wife is a musician, and they have two adult children together. He even has an asteroid named after him: “(289116) Zurbuchen”.

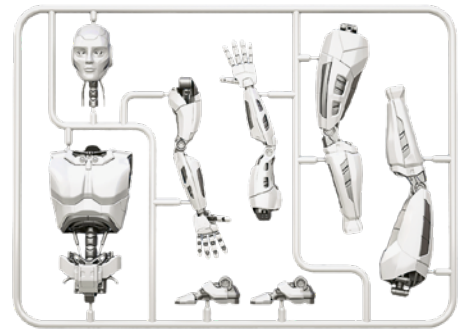


For a live view of the Moon, check out “Eyes on the Solar System”

maxon motors are being used in a large number of current lunar landing missions. The image shows NASA’s Odysseus space probe, which touched down on the lunar surface on February 22, 2024 and has been sending usable data back to Earth ever since.



Photos: Intuitive Machines; ETH-Rat Daniel Kellenberger; Stock.com/Leax; Fourier Intelligence



**SUPERBEINGS**

# WILL WE LIVE FOREVER?

“I think it’s possible, because the human body actually has all the tools to repair itself. For example, if we cut ourselves as children, the wound heals within a few days and leaves no trace. But as we age, the rate of cell renewal is lower than the rate of aging. This is the reason why our body no longer regenerates itself. I see three ways to change this:

1. We find a way to optimize the equation, either slowing down the aging rate or speeding up the renewal rate.
2. We find a way to replace aging body parts – robotics will play a major role here – or to grow new ones from stem cells. As long as the brain is alive, we could renew the body indefinitely.
3. If options 1 and 2 are unsuccessful, we still have the option of uploading the brain to the cloud. At least this way we can live forever digitally.

Does that sound crazy? Modern toasters have more computing power than the Apollo 11 lunar mission, which was just over 50 years ago. We should never underestimate the power of innovation.”



**Zen Koh** is Global CEO of Fourier Intelligence, a Singapore-based startup that develops exoskeletons and rehabilitation robots. “Personally, I don’t think much about eternal life,” he says. “But I certainly wouldn’t say no to it.”





"Lunch atop a Skyscraper", a photo of construction workers taken in 1932, looks like something from a bygone era. There are still many dangerous jobs out there. But for how much longer?



Photo: Bettmann-Kontributor / Getty Images; Photomontage: Peter Kruppa



BRAVE ROBOTS

# WILL DANGEROUS JOBS SOON CEASE TO EXIST?



Drones could fly into danger zones to carry out maintenance work.

There are still some limitations, however. Our drone can fly for up to 24 minutes, which is the longest amount of time in the industry and sufficient for many applications. As the energy density of batteries increases, an hour-long flight should be possible in a few years."

"Every year, around 2.1 million workers have to enter confined spaces – enclosed spaces where the door is actually better left closed: storage silos, tanks, sewers, etc. Confined spaces are dangerous places, leading to the death of two people every week. Aside from the many accidents that occur, they are not pleasant places in which to work.

For years there was little effort to improve this situation, but that has changed with recent technical advances. Two approaches are helping ensure that confined spaces have to be entered less often.

On the one hand, incredible advances have been made in sensor technology, which means that we generally know more about the conditions in confined spaces. On the other hand, there's a wide variety of new robots. They can crawl, swim, fly, or climb – and use these skills to explore confined spaces.

Obviously, I'm biased, but I find drones the most interesting because they offer endless possibilities in three-dimensional space. They can go almost anywhere, and are fast and reliable. For example, they can already examine a wall for cracks and will soon be able to carry out maintenance work such as scraping off soot.



**Samir Bouabdallah** is cofounder and CEO of Flybotix, a drone company based in Lausanne. Bouabdallah has a PhD in robotics from the EPFL. "I've been fascinated by robots since I was a child," says the native Algerian. "I built my first one when I was six. It was made from my mother's old shampoo bottle and powered by parts of her blow-dryer. She wasn't too happy about it at the time, but now we both laugh about it."

**"Working with maxon plays a decisive role in the success of Flybotix. Together we designed a motor that is perfect for drones in terms of form and performance. It was a great experience. We learned a lot from each other. And I'm very proud of the result."**

**Samir Bouabdallah**



Photos: Flybotix SA, Sébastien Agnelli

Photos: Enchanted Tools, Alain Herzog, Fourier Intelligence



**GROWING OLDER**

# WILL ROBOTS TAKE CARE OF US?

“Yes, I can well imagine that being the case. From a functional point of view, I don’t see any problems. Robots can assemble cars or spend years exploring Mars, so I’m sure they’ll manage to bring us our pillboxes. There is another issue, however: humans. Human behavior is so unpredictable that the robot has to constantly respond to it, and robots are still severely overwhelmed in unstructured situations.”



**Zen Koh** is CEO of Fourier Intelligence, a Singapore-based startup that develops exoskeletons as well as rehabilitation and nursing robots. In the summer of 2023, Fourier brought a humanoid nursing robot onto the market that received a lot of media attention and drew comparisons with Tesla’s counterpart. “I’m delighted, but I’m not making a big deal about it. I don’t want Elon Musk to challenge me to a fight like he did with Mark Zuckerberg from Facebook,” says Koh.

Miroki is a little fox whose cute and lovable appearance is much more appealing to people compared with other robots. This is important for greater acceptance of future healthcare robots. French startup Enchanted Tools is building Miroki, a new generation of useful humanoid service robot.

## NEW IDEAS

# ARE WOMEN DRIVING A NEW TECHNOLOGICAL REVOLUTION?

“In the universities and laboratories where I’ve worked, the proportion of women in robotics is 15 to 20 percent – at best. It’s clear that a crucial demographic is being systematically excluded, which is sad because the market is missing out on the diversity of ideas and bright minds. Countless studies show that diverse teams deliver better results. Women and men have different ways of understanding and thinking about problems. Both perspectives can be crucial in finding solutions.

The big question therefore is: What needs to happen to get more women working in robotics? The short answer is: a lot. And the long answer?

I believe we need to be careful about how exactly we foster this change. For example, I don’t think that seminars along the lines of “How women successfully build robots” are really going to arouse much interest. From a strategic perspective, it makes much more sense to host cool scientific events that focus on technology and ensure that a sufficient number of women are represented on the stage. Role models are important.

Since I became director of the Vision for Robotics Lab at ETH, I’ve noticed how interest from female students in my work is increasing. I also notice it in myself. When I need advice, I instinctively look for a female first because I implicitly assume that she will understand me a little better. That said, in my career so far, I’ve been fortunate to have been surrounded by visionary male colleagues and mentors whose advice has often proven crucial to me. Therefore, I’m convinced that both men and women need to play an active role in bringing about positive change in the area of equality.

This is because – and I’m sorry to have to say this – discrimination isn’t just confined to industry; it still happens a lot at universities as well. Non-academics often regard universities as a perfect environment that sees beyond discrimination and focuses on aca-



Research into the perception capabilities of drones in real time at ETH.

ademic merit, but the truth is that universities are affected by discrimination just as much as the rest of the world. Sometimes the discrimination is subtle, for example not inviting women to speak at seminars. Sometimes it’s obvious. Unfortunately, most, if not all, female technology students have received comments such as: “Are you the secretary?” “What do women know about technology?” “You should be at home looking after your children.”

An important change in the right direction would be for society to become more family-friendly. I think this is not only important for women, but many men today also understand and want this themselves. Just imagine the impact such a change would have on staff recruitment, team diversity, and the quality of care for our children.

As far as the future is concerned, I’m cautiously optimistic about the situation in industrialized countries. By the time my generation and the next generation take over, questions of gender, sexual orientation, and

ethnic origin will be much better understood. Take religion, for example: In Switzerland 50 years ago, being Catholic, Protestant, or Muslim had an influence on your career. Fortunately, today this is less important and will hopefully become completely irrelevant.”



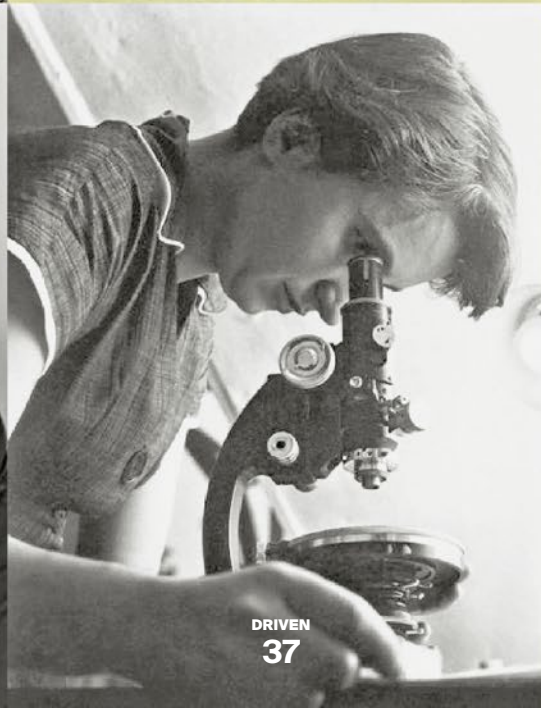
**Margarita Chli** is a professor of robotics and director of the Vision for Robotics Lab at ETH Zurich and the University of Cyprus. Chli grew up in Cyprus. Both of her parents were math teachers. “My father did a lot of physics experiments at home,” says Chli. “He wanted to show me that I can find a logical answer to every question. And my mother had an infectious passion for adopting a methodical approach.” How did Chli end up working in the field of robotics? Is there anything cooler than putting math, physics, and engineering into practice to create robots that can help people? I can’t think of anything.”

Indispensable: Inventions by women, without which our world would be a different place.

Top row: Ada Lovelace (world’s first algorithm), Marie Curie (radioactivity), Grace Hopper (user-friendly programming language).

Middle row: Hedy Lamarr (frequency hopping technology), Josephine Cochrane (dishwasher), Maria Telkes (solar heating).

Bottom row: Patricia Bath – also depicted on the cover (laser cataract surgery), Rosalind Franklin (DNA double helix), Stephanie Kwolek (Kevlar).





WILL IT STILL EXIST?

# WHAT WILL REHABILITATION BE LIKE IN THE FUTURE?

“A revolution is underway in neurological rehabilitation. Wearables and implants are becoming increasingly important, as are rehabilitation robots and artificial intelligence. With these tools we’ll be able to stimulate the brain in a completely different way than we do today and massively accelerate the formation of new neuronal connections. But that’s not the point.

For me, what’s more important is that a lot less rehabilitation will – hopefully – be needed in the future. Why? Because we’ll lead a healthier lifestyle and, with the help of technological aids, we’ll know much more about the state of our bodies. Your watch will tell you: “You need to get a few steps in,” “Your salt level is too high,” or “No more chocolate today.” The number of strokes and other lifestyle-related neurological diseases will decrease by up to 90 percent.

The MetaMotus™ Galileo is a biomechanical analysis and rehabilitation platform that combines virtual reality (VR) and robotics.

Yes, my company builds rehabilitation robots and profits from neurological diseases. But honestly, my goal is that one day we won’t be needed anymore.”



**Zen Koh** is CEO of Fourier Intelligence, a Singapore-based startup that develops exoskeletons and rehabilitation robots. His company is named after a French mathematician: “Fourier is best known for his mathematical transform,” says Koh. “We want to transform human ability.”

**“We worked with maxon from the beginning when developing our exoskeleton. maxon’s products are extremely reliable and the quality is very high.”**

**Zen Koh**



Image generated with Midjourney (Prompt: “In a virtual world: from a VR perspective. Old people (60, do fitness”). Photos: Fourier Intelligence

## Expertise



**Mario Mauerer**  
Business Development  
Manager Robotics

# BEYOND ASIMOV: PUSHING THE POSSIBILITIES WITH NEXT-GENERATION DRIVE SYSTEMS

In exploring the future of robotic actuation systems, envision a world where autonomous robots seamlessly integrate into daily life, from delivering parcels to cleaning hotel rooms. This transformative vision, though uncertain, hints at a reality closer than we imagine.



Photo: maxongroup; image generated using Midjourney (Prompt: "A beautiful green city in the future. Many people live together with robots as helpers.")



Together with inputs from a few colleagues at maxon, I would like to paint a picture of how a next-generation (robotic) actuation system might look. We can by no means predict the future, but we can extrapolate a few trends to form a vision. First of all, imagine that, soon, autonomous robots will have permeated virtually all aspects of society. Autonomous cars and sidewalk delivery robots are just the beginning. Your letters and parcels will be deposited and collected by swarms of robots. Exoskeleton-equipped workers will, together with quadruped companions, build infrastructure. A robot will happily clean your hotel room (including the toilet!). There will be daycare robots entertaining kids in the sandbox (and take their diapers out). Apples are picked autonomously. You get the idea. I think that this world will become a reality sooner than we currently anticipate.

**Aspects of Next-Gen Drive Systems**

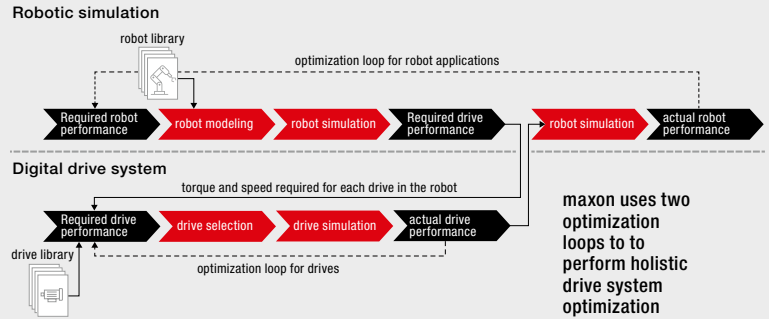
Let's highlight some aspects of next-generation drive systems that will facilitate this transformation. First, safety will be essential. Millions of autonomous robots will operate in shared spaces with (soft and vulnerable) humans. This means that their drives must inherently provide some safety-relevant features. Safe-torque-off is only the very beginning. At some point, a safe provision of torque and motion will be required, which constitutes a whole new dimension of complexity (and capability).

Drives will require an ever-deeper integration of subsystems in order to provide all necessary functions in a limited space. "Industrial Lego" will not be possible anymore. System boundaries become more fuzzy and interdependent. As Max Erick Busse-Grawitz says: "Actuators will become structural elements, and no one will want to (or even, can) deal with cables anymore; communication and power transfer needs to be combined". This integration trend will be enabled by new materials and production methods (as it always does). One aspect that starts to accelerate a deep integration already today is advanced system simulations. Such tools allow a deep system optimization and validation. Tobias Wellerdieck, who creates such models with his team at CCSY-RDS, wants to make sure that "a roboticist can build a robot and it will just work, because they sufficiently simulated all sensors, actuators, and control systems beforehand. Creating new robots is becoming really easy".

The next paradigm change relates to compute. First, one obvious enabler is machine learning. Advanced models or algorithms will be executed directly on the actuators, and will be sunseting traditional, loop-based and cascaded control topologies due to their ability to deal with more complex and diverse data. This might also imply, as Max Erick further suggests, that actuators will integrate many more sensors like IMUs or microphones to enable predictive maintenance or fail-save behavior at the joint level. Such sensors will also facilitate adaptive learning, where systems inherently autonomously react to changing conditions, like wear or defects, not via pre-programmed

**Simulation of Drive Systems for Robotics**

Our robotic system simulation workflow as employed by our CCSY-RDS allows for holistically iterated system optimizations and enables customers to select the right actuation solution.



**HEJ 90-48-140**  
 Our High Efficiency Joint, an example of our growing portfolio of integrated drive systems suitable for robotics. By providing the complete system solution, we enable our customers to fully focus on robotics, while we tackle the nitty-gritty complexities of high-performance actuation for them.

behaviors, but through an intrinsic knowledge of their architecture, interface and purpose. A second aspect to compute is its spatial distribution. I think that the compute system of a robot will become more centralized, dealing with all sensor data at a single location, whereas Tobias Wellerdieck suggests that compute capacity could be more distributed across a robot - including the actuators. Nonetheless, all data created by actuation systems will be collected and either used locally and directly for control, or for preventive maintenance of individual robots or entire fleets. Future (wireless) connectivity advances will enable the transfer of massive amounts of data - and potentially even the real-time control of robots from the "cloud".

**Focus on reliability and low maintenance**

Finally, one more emerging aspect of more complex drive systems are life cycle considerations. Actuators must not only be produced sustainably, but operate with minimal or no maintenance at a high efficiency. Fleets of millions of robots, many of them battery powered, must show a high degree of reliability and require only minimal maintenance, to further boost their adoption and reduce total cost of ownership. This has some interesting implications for the business model of drive system providers, which, for the sake of brevity, I encourage you to have a discussion with your preferred large language model about.

I truly think that we are in the early phases of a wider robotic revolution. Next-generation drive systems will render this deep societal transformation ever more possible. We at maxon look forward to the challenge of helping actively shape this exciting chapter in human history. ■

# Hey, ChatGPT, will technology save us or destroy us?

CHATGPT text (slightly shortened)



**In an era where technology is surrounding us with breathtaking speed, we need to ask ourselves: Will these digital helpers be our saviors or will we slide inexorably into the abyss? In this column we take a look at the ambivalent relationship between humans and machines.**

## **The two sides of the technology coin**

*Medical advances:* An epic drama surrounding healing is unfolding in hospitals and laboratories. Medicine, supported by high-tech devices and innovative therapeutic approaches, has the potential to defeat diseases that were once considered unconquerable. The question is no longer whether we can conquer diseases, but rather how many and how quickly.

*Environmental protection as a guiding principle:* The green revolution will be driven by technological innovation. From renewable energy sources to smart cities that optimize energy consumption, technological advances could put us on a sustainable path. The potential is huge, but so are the challenges.

*Education, knowledge, and global networking:* The digital era has freed education from its traditional boundaries. Access to knowledge is now global, and the opportunity to learn from the best is as easy as a click of a mouse. Our world is getting smaller, and awareness of global challenges is growing. But while we are connected, shadows also lurk in the depths of cyberspace.

## **On the edge of self-destruction**

*Weapons as a product of technology:* In the midst of progress lurks a shadowy army of destruction. Sophisticated weapons systems controlled by algorithms and artificial intelligence could fall into the wrong hands. A world in which technology serves as an instrument of war rather than peace could destroy us faster than we could ever imagine.

*Surveillance and data protection:* The dark silhouette of surveillance and data protection hangs over our digital presence. The

convenience that technology brings could come at a cost in the form of loss of privacy. The power we give to digital platforms could be used as a weapon against individual freedom.

*Artificial intelligence without a moral compass:* In AI development labs, a journey into the uncharted waters of artificial intelligence is being undertaken. Without clear ethical guidelines, the creation we have called into being could get out of control. Autonomous systems that operate without any control could open a modern-day Pandora's Box.

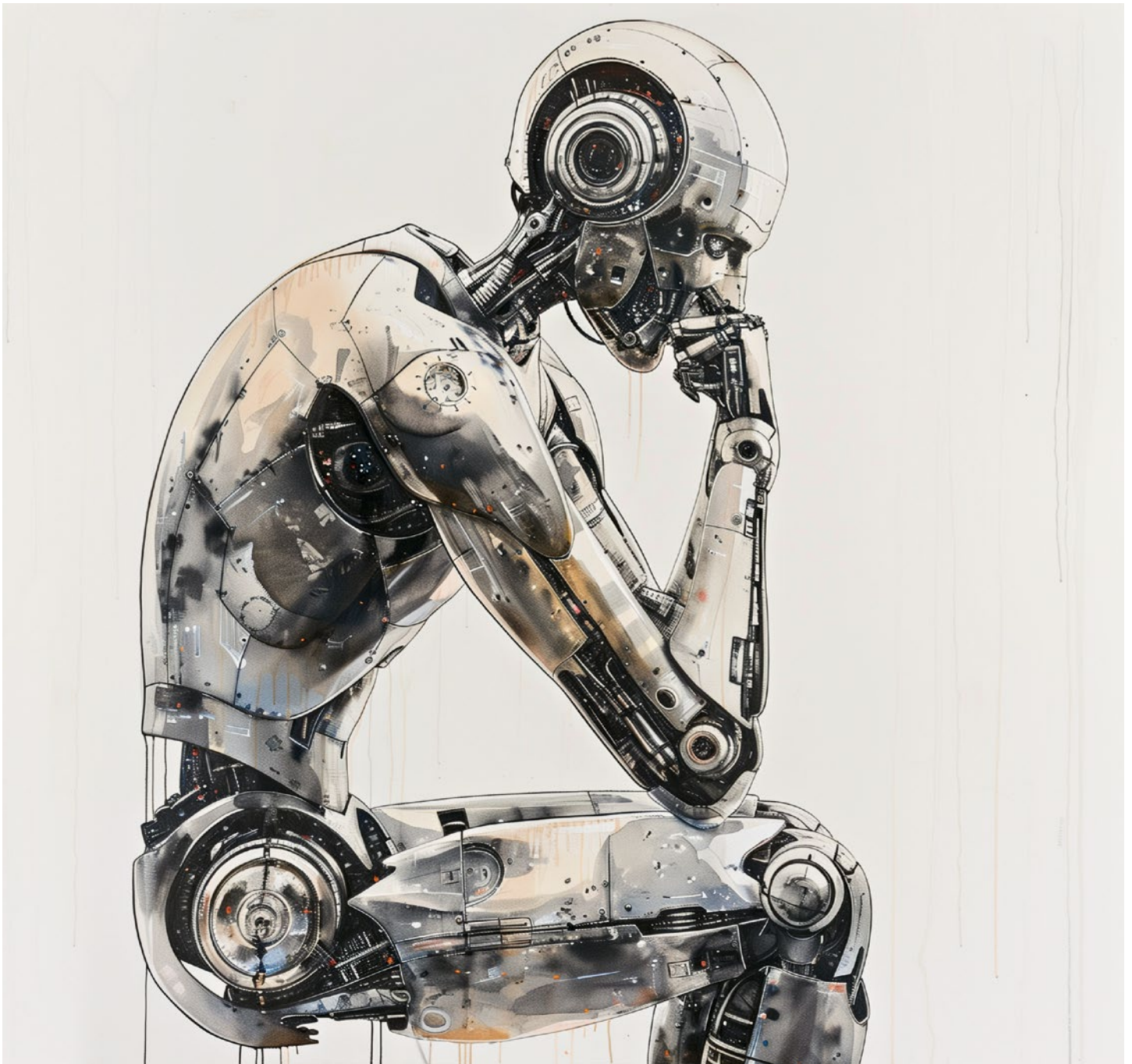
## **The scales of balance and responsibility**

As a society, we find ourselves in the midst of a technological storm. The future relationship between humans and machines depends on the decisions we make. The ability to control the direction of technological development lies in our hands.

*Governance:* With regulations, ethical guidelines, and responsible use, we can shape technology to support our shared goals. A collective awareness of the power and responsibility that come with technology could lead us on a path to sustainable development.

*Education and awareness:* Empowering people to understand and think critically about the impact of technology is crucial. Promoting education and awareness about technology could enable us as a society to make smart decisions.

In a final act that is yet to be written, we as actors on the world stage must decide whether the technology coin is a symbol of salvation or a warning of destruction. The choice is ours. May reason prevail in this technological saga. ■■■



# Power your Robots with Precision

Discover our state-of-the-art drive systems for robotics that will take your projects to the next level. With a wide range of encoders, joints, and motors, we offer you the precision and performance you need to realize your vision. Give your project a decisive advantage with our reliable drive solutions:  
[robotics.maxongroup.com](http://robotics.maxongroup.com)



Precision Drive Systems

**maxon**

“

**A wonderful  
example of  
outstanding  
Swiss  
engineering.**

”

Dr. Thomas Zurbuchen on his maxon e-bike.