DRIVEN

by maxon

60 Years of Excellence
Est. 1961

Pushing the limits: how technology makes us stronger

Contents

DRIVEN by maxon

The heros of this edition

THE DRIVE SYSTEM

BIKEDRIVE AIR S

→ New mid-mounted motor for e-bikes
p. 30

THE ROBUST ONE

HIGH EFFICIENCY JOINT

→ Universal training system
p. 43

THE EXACT ONE

HIGH PRECISION JOINT

→ Expertise in robotics
p. 45

THE OPTIMIZED ONES

EC-I MOTORS

→ Wearable exosuit
p. 27

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Eugen Elmiger
CEO maxon Group

From a dream to a solution

What technology can achieve rarely reveals itself in grand words, but rather in the everyday moments. One conversation in particular stayed with me: A man who worked as a roofer fell from a roof and has been paralyzed ever since. He said: “My greatest dream is to stand up again.”

This sentence sparked something in us. Together with partners, we developed a wheelchair that fulfills this wish, at least partially. It’s not revolutionary, but rather the outcome of good teamwork, technical know-how, and genuine motivation. Experiences like this show me: assistive technologies are no longer just a topic for the future. They are part of our lives: Not only for rehabilitation, mobility, or leisure but also people with impairments. And for a society that is aging, yet wants to live more actively and flexibly.

This requires new solutions. At maxon, our work centers on these intersections: bridging technology and application, and linking tailored development with scalable drive systems. In this issue, we present some examples that inspire us – and where we have a hand in shaping the outcome.

I hope you find it an interesting read!

Ready for the spotlight: AEON merges Swiss precision with AI

In Las Vegas, Hexagon introduced AEON, a humanoid robot for industrial applications that stands out for its advanced technology and Swiss precision. Actuators by maxon enhance AEON to move around. AEON was developed to help counter the shortage of skilled workers, by performing tasks such as inspections, manipulation, and digital recording in industrial environments. This is made possible through a combination of AI-based spatial intelligence, sensor fusion, and maxon's proven drive technology. The latter is what provides AEON with its exceptional agility and efficiency. Hexagon forged strong partnerships for AEON's development: with maxon for drive technology, NVIDIA for high-performance computing, and Microsoft Azure for scalable development and AI training. The next step is to test AEON in real-world environments, such as at Pilatus Aircraft Ltd., the Swiss aircraft manufacturer.

maxon

NVIDIA

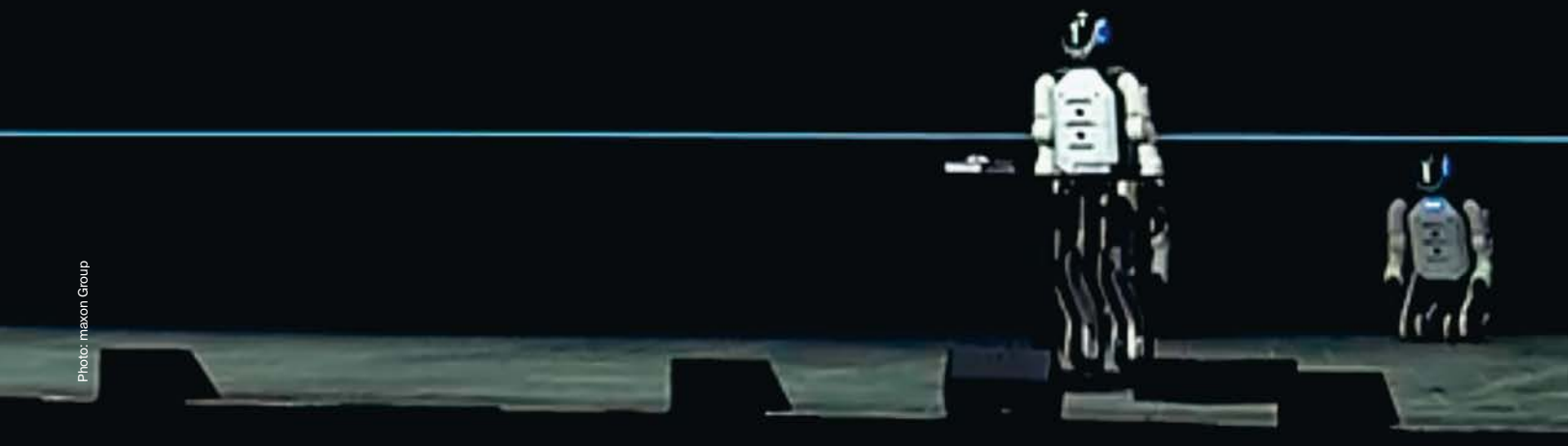


Photo: maxon Group

In memory of Jürgen Mayer

The man who took maxon to Mars

It started as a stopgap. Back in 1967, Jürgen Mayer was waiting for a work permit for Beirut. Instead, he ended up at Interelectric in Sachseln, the predecessor company of maxon. He thought it would only be short stop. Five decades later, the mechanical engineer had become the architect of a global brand. And the man who took maxon to Mars.

In 1997, when the Jet Propulsion Laboratory inquired whether maxon could provide motors for a rover, Mayer first assumed they were kidding. Yet he listened carefully to what they needed – and accepted. Soon after, Sojourner landed on the Red Planet. Eleven motors from Obwalden enabled the robot to move. Mayer sensed the significance of that moment – for the business, the brand, and the Swiss identity.

Starting as a draftsman, he moved on to sales, to the executive board, and eventually to the helm. Under his leadership, the revenue and staff numbers multiplied, but what mattered was not growth at any cost – it was impact. Mayer believed in technology that serves a purpose – and in giving people the freedom to develop ideas.

In 2005, he wrote: **“If you want to succeed, you have to roll up your sleeves – and from time to time, also rethink everything.”** He did both.

He was not an easy boss to have. Direct, sometimes impatient – but loyal, witty, and principled. Outside of work, he flew gliders, painted, enjoyed music, loved wine, and engaged in politics. A person with character, curiosity and energy.

On March 11, Jürgen Mayer passed away at the age of 86. But what he set in motion keeps going – on Earth as well as in space.

Photos: AMZ; yeven popov / Freepik; maxon group; iStock.com / ismagilov; iStock.com / 1xpert; SolarButterfly

CTO Stefan Müller (center) accepted the award together with a delegation at the Robotics Summit & Expo in Boston. Senior Sales Engineer Joe Martino (left) and Alessandro Forino, Head of Robotic Drive Systems, join him in the photo.

maxon as a trailblazer

Award-winning robotics

The international platform *The Robot Report* honored maxon with the Robotics Innovation Award 2025. The compact and precise High Efficiency Joints (HEJ 70 & HEJ 90) were recognized. The official statement says: “The compact drives from maxon are crucial trailblazers for the next generation of robots – more intelligent, smaller, and more agile.”
CTO Stefan Müller accepted the award at the Robotics Summit & Expo in Boston, accompanied by a delegation. The new joint units combine motor, gearhead, sensors, and control electronics in a compact housing – ideal for mobile manipulators and humanoid robots. Out of all 50 awarded innovations, the HEJ was the only actuator chosen.

Racing ahead

Brand ambassador in the cockpit: Sébastien Buemi visits AMZ Racing

Formula E driver and maxon brand ambassador Sébastien Buemi visited the Swiss based Formula Student team of AMZ Racing ahead of their official vehicle launch in Dübendorf – and had a turn behind the wheel of their 2024 prototype himself. “These cars are technically extremely sophisticated – what the team has achieved here is remarkable,” Buemi said after the test drive. Shortly thereafter, the new race car, Aurona, was unveiled at maxon’s headquarters in Sachseln, during a ceremony attended by more than 300 guests. Since 2022, maxon has been the main sponsor of AMZ Racing, providing engineering support, components, and extensive technical expertise.

Watch the video of the visit in Dübendorf:

43.5 kW

Power supplied by each of the four motors

2.46 kg

Weight of a motor with maxon windings

17 kg

Weight of the carbon monocoque for the chassis

387 Nm

Torque per drive unit through the planetary gearhead

588 V

Maximum voltage of the high-voltage battery

12,000

Number of signals that the vehicle processes electronically

350

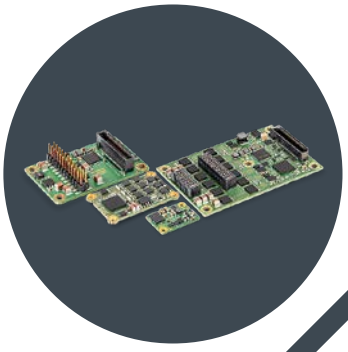
meters of cable can be found in the vehicle

At maxon's headquarters in Sachseln, the AMZ Racing Team unveiled its new race car, "Aurona." AMZ stands for Academic Motorsports Club Zurich. Supported by maxon, the team developed a vehicle in eight months, featuring four high-performance motors, a carbon monocoque, innovative aerodynamics, and self-driving capabilities. In addition to XXL windings, maxon contributed engineering expertise and testing resources.

Find out more about the AMZ Racing Team

Photo: maxon Group

New products



ESCON2
Universally applicable

ESCON2 product line

New servo controllers for more flexibility

The ESCON2 product series of maxon continues to grow: New models in various designs and performance classes greatly expand the application range of the compact servo controllers. Current offerings include the miniaturized ESCON2 Nano 24/2 (weighing only 2.5 grams), the Micro 60/5, and various module and housing options. More models will follow by year's end. All versions share a common technical platform featuring field-oriented control (FOC), fast control loops, and versatile interfaces (CANopen, RS232, USB). The new Motion Studio software makes commissioning and system optimization easier.
The ESCON2 controllers provide precise speed, current, and position control, making them key system components for demanding applications in robotics, medical technology, laboratory automation, and industrial systems, perfectly matched to maxon motors and drive systems.

IDX 70
Powerfully efficient

IDX 70

Compact powerhouse

The IDX 70 drive system is a powerful BLDC motor with an integrated EPOS4 position controller and the compact GB65 angular gearhead from Parvalux. All packed into a sturdy IP65 housing, ideal for use in robotics, automation, and logistics.
With a housing width of just 70 mm, the system delivers up to 750 W, 7.3 Nm peak torque, and speeds of up to 6,000 rpm, all in roughly 25% less space than similar systems. The high power density makes it the ideal solution for tight spaces.
The GB65 gearhead, available with ratios up to 160:1, delivers up to 120 Nm continuous and 300 Nm peak torque. It is available with steel or bronze teeth, and operates quietly and efficiently.
The EPOS4 controller allows precise positioning, easy setup with Startup Wizard and Auto Tuning, and integration via EtherCAT or CANopen. An integrated temperature sensor protects against overheating. A thoughtfully engineered and compact complete system for demanding environments.

MAXON ONLINE SHOP
Here you will find more than 6,000 products, selection aids, combination tools, and comprehensive product information:
shop.maxongroup.com

Photos: maxon Group

Beyond Assistance –

How modern technologies empower people, engineering and society

Illustration: Alexander Glandien

Assistive technology – it sounds dry, technical, maybe a bit distant. Yet it's already a normal part of life for people with impairments, but also for everyone else. It helps humans, enhances their abilities, anticipates needs – and raises fundamental questions: What is good help? Where does technology make the most sense? And shouldn't it also be fun?

Text: Urs-Ueli Schorno

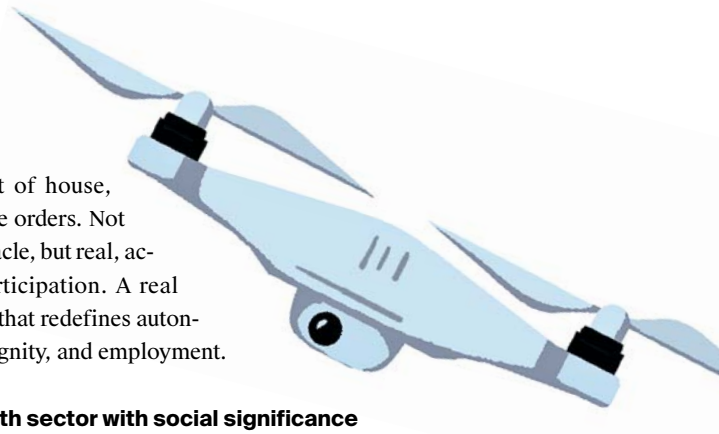
In pop culture, high-tech assistive systems save entire worlds – with empathy, efficiency, or firepower. In "Star Wars", R2-D2 opens doors, defuses bombs, and stores vital data. Jarvis, the AI assistant in "Iron Man", controls the home, monitors systems, chats with Tony Stark – and later becomes a key character as part of Iron Man's suit.

In "Avatar" humans control giant robotic arms to survive on an alien planet. In "Edge of Tomorrow", an exoskeleton boosts soldiers' combat strength in the war against aliens. Even as far back as the 1950s Japanese classic "Astro Boy", a highly intelligent, childlike robot helps those around him. A common theme: In anime, robots are usually friends and helpers.

Yet the roles sometimes reverse: In "Terminator" and "The Matrix", robots become a threat to humanity. And in 2001: "A Space Odyssey," Stanley Kubrick's 1968 classic, the on-board artificial intelligence takes control of the human spacecraft.

How close are the dreams and nightmares created in film studios to reality? And what can we expect from assistive technologies now and in the future?

As always, reality falls between extremes, somewhere between science and fiction. A real example from the land of robotics shows what's already possible: Café Dawn in Tokyo. Here, humanoid robots take orders and serve drinks. They are, in a way, avatars: They aren't autonomous – they're controlled by people with severe physical disabilities, using eye or head movements, from nursing homes or their own homes. Communication is achieved through speakers: either using spoken voice or text-to-speech software. Many of the operators can barely speak or move, yet they interact live with guests and peers, work in front of house, and take orders. Not a spectacle, but real, active participation. A real system that redefines autonomy, dignity, and employment.



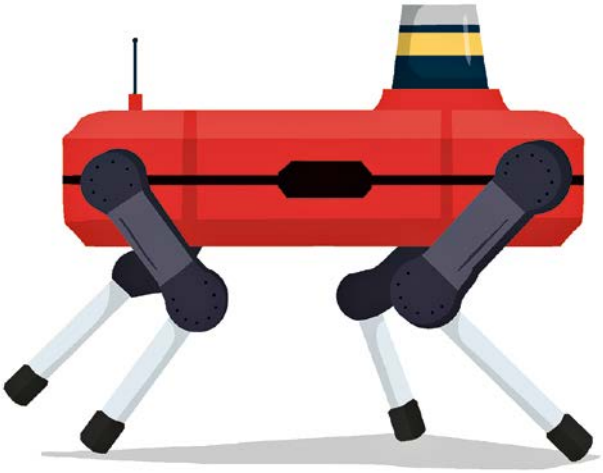
A growth sector with social significance

What used to be seen as simple aids for elderly or disabled people, like wheelchairs, canes, prostheses, or a patient lift, is today being reimagined as smart technology that supports and enhances natural movement and everyday activities, or even makes it possible for those who previously couldn't move.

The new generation of assistive systems is networked, capable of learning, and designed to foster inclusion. They promise efficiency, autonomy, and personal empowerment. They are viewed with hope and curiosity, yet also caution and apprehension.

And yet: there are clear signs these systems are moving out of their niche and starting to take root in daily life.

Actually, it all starts with a simple question: How do we want to grow old? The numbers give us answers: Eurostat projects that by 2050, roughly a third of Europe's population will be aged over 60. Even today, 61% of Germans over 60 want smart assistive systems in their living environment, according to a Fraunhofer Institute study on technology acceptance. No wonder the market is growing: In 2022, over 158,000 professional service robots were sold worldwide, up 48 percent from the previous year, according to the World Robotics Report. And last but not least, Fortune Business magazine estimates the global exoskeleton market will exceed 8 billion US dollar by 2030.



"The technology must be developed together with people."

Robert Riener, Professor of Sensory-Motor Systems at ETH Zurich, capitalize Inventor of the Cybathlon

Illustration: Alexander Glandien

“Actually, it all starts with a simple question: How do we want to grow old?”

Everyday life shows: A lot is possible, but not everything is ready for the market. The medical field makes it especially clear where we stand. “Today, exoskeletons are being used more and more frequently as aids for people with disabilities. They also already play an important role in rehabilitation,” says Thomas Mayer, head of the Medical business unit at maxon. “The market is still in its early stages, but it will continue to develop,” he states confidently. At the Cybathlon, a competition for assistance technologies initiated by ETH Zurich, prototypes are often involved. “Most of what’s created there is proof of concept – yet it demonstrates what can be achieved.”

Before we start dreaming about superpowers, it’s worth looking at what already works reliably – cases where technology supports rather than replaces. These are systems that compensate for limitations, restore mobility, and enable participation – as precise technical tools in daily life. This is exactly where the story of modern assistance technology begins.

Support: Developed for people

Assistance starts where technology helps to reclaim everyday life: Today’s rehabilitation systems, patient lifts, and electric wheelchairs contain advanced drive technology. Systems like Adam’s Hand – an intelligent hand prosthesis from Italy powered by maxon drives – demonstrate how fine motor functions can be regained. Similarly, exoskeletons such as those used in pilot projects in clinics or in sports can increase autonomy, though currently they serve primarily as supplementary support. The path to a full “stand-alone” solution for people who can’t walk is still long and sometimes bumpy.

Technology alone isn’t enough. What matters is how well it’s integrated into daily life – functionally, socially, and emotionally. This is exactly where the concept of human-centered design comes in: Systems should be not only technically possible but also must make sense for people’s lives. They must be intuitive to use, accepted, and easy to understand – and most importantly, designed in cooperation with the people affected. Not just for functionality, but also to boost acceptance.

“The technology must be developed together with people.” That statement comes from Robert Riener, Professor of Sensory-Motor Systems at ETH Zurich, leading robotics researcher, and inventor of the Cybathlon. He summarizes a key insight: “If you only think from a technical perspective, you easily miss what users truly need.”

This is also evident in the smart home, where everyday assistance is becoming increasingly concrete: Lifts, door openers, lighting control, and cooling – combined with sensors, AI, and motors – create new possibilities for independent living at home. But in the end, it’s people who decide which of these are truly useful. Just because a fridge can order milk on its own doesn’t mean it should (perhaps I’ve spontaneously decided to switch to oat milk instead of cow’s milk today).

Max Erick Busse-Grawitz, Technology Transfer Officer at maxon, has noticed a growing interest in subsystems that can be flexibly integrated – not just for household or mobility robots. The challenge: balancing precision and agility – and doing it at an acceptable price.

His bottom line: “Our hardware is now advanced enough to be a reliable foundation for other systems. That enables our customers to focus entirely on what truly sets their solutions apart – like software, control, or user interaction.”

Expansion: Making new things possible

Modern assistive systems not only compensates for disabilities – they also push the limits. Another example from the field of medical technology can be found in surgical

“People who are 70 today think differently about performance than seventy-year-olds did twenty years ago.”
Andreas Richter, COO of the maxon Group

applications: systems like “Da Vinci” of Intuitive Surgical allow operations with accuracy down to the millimeter and are frequently much more precise than a human hand.

In healthcare and logistics, robotic systems are also being tested or deployed, to ease physical strain on people, stabilize processes, or make movements more precise. Felix Herger, head of maxon’s Industrial business unit, points out that this isn’t just about research, but increasingly about commercially viable series products: “Patient lifts, stairlifts, surgical robots – we’re not talking about niche solutions, but about technologies that will become part of everyday life for many people.” This, according to Herger, is precisely why it’s already part of everyday industrial practice.

There’s a fine and shifting line between aiding and extending human abilities. Technology doesn’t just restore what was lost – it makes new things possible. People with impairments gain abilities beyond the commonplace – like fine motor precision or remote control. And people without impairments are also increasingly benefiting: in lifting heavy loads, managing complex work processes, or working in environments inaccessible to unaided humans – such as construction sites, operating rooms, oil platforms, or outer space.

From a technical standpoint, this means: drives need to be suitable for flexible integration into complex architectures while ensuring maximum reliability and controllability. Tailored solutions are still key – but there is a growing demand for modular subsystems like maxon’s High Efficiency Joint (HEJ), a highly efficient, compact, and fully integrated drive for robot joints. It demonstrates how customization and scalability can be combined even in safety-critical applications. Hopefully, as the market expands, the required certifications and the regulatory demands will drop to a tolerable degree. Safe technology should not only be available but also affordable.

Inspire: Technology that’s fun

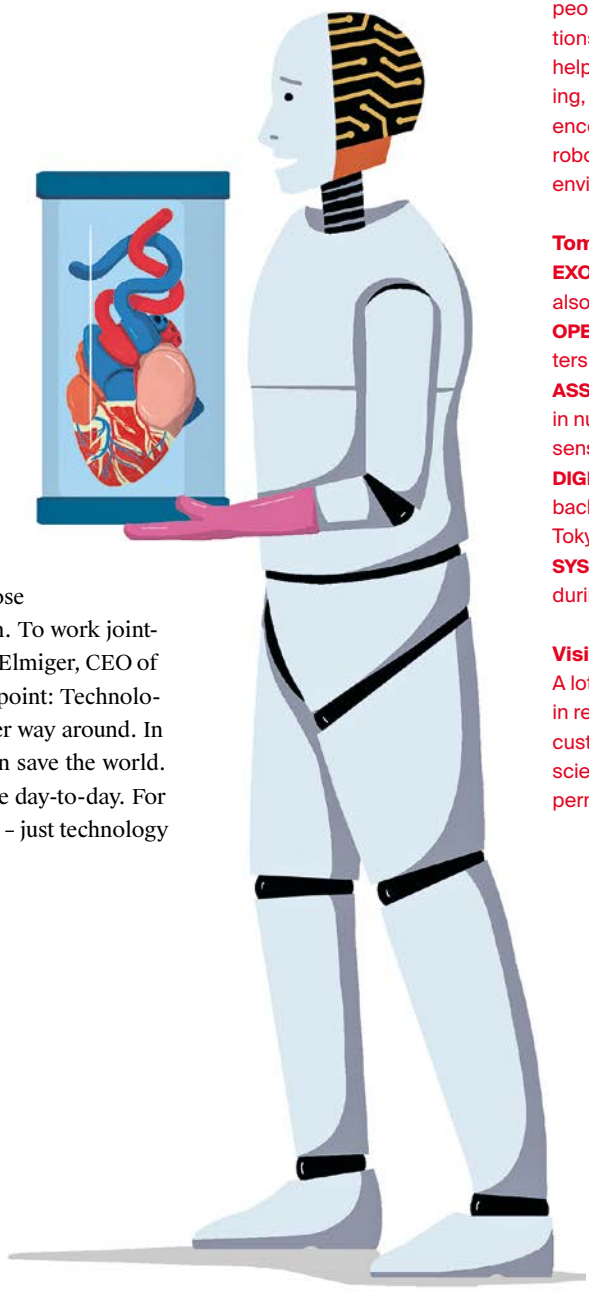
And last but not least: assistive systems should also bring joy. They can prolong adventures and help achieve goals when one’s own strength isn’t quite enough. The new BIKEDRIVE AIR S from maxon adds an almost invisible drive to a sports bike. In both hiking and therapeutic sports, exoskeletons are gaining importance: They create experiences where there used to be barriers, or simply make life a bit easier.

“People who are 70 today think differently about performance than seventy-year-olds did twenty years ago,” says Andreas Richter, COO of the maxon Group. “Technology can enable you to do things – without doing them for you.”

Perhaps technology is most inspiring when it enables shared moments – like a father and daughter still being able to cycle together.

Illustration: Alexander Glandien

“For the future, we don’t need superpowers – just technology made by people for people.”



In a nutshell: looking ahead with conviction

Assistive systems are not futuristic fantasy. They exist – as tangible, growing, learning technologies. Not everything is fully matured yet. But the direction is clear: The systems are becoming more reliable, more accessible, and more integrated. They’re needed now more than ever – because we’re living longer and want to remain independent. It is crucial that technology must be guided by human needs. “My dream is to bring all these people – developers, experts, those affected – to the same table. At maxon. To work jointly on solutions.” This vision of Eugen Elmiger, CEO of the maxon Group, gets straight to the point: Technology must adapt to people – not the other way around. In science fiction, assistive systems often save the world. In reality, they sometimes just save the day-to-day. For the future, we don’t need superpowers – just technology made by people for people.

What are assistive systems – and what does the future hold?

Assistive systems are technologies that support people in daily life, at work, or in exceptional situations – physically, cognitively, or emotionally. They help with walking, grasping, thinking, communicating, controlling, or making decisions. Today, we encounter them as prosthetics, exoskeletons, rehab robots, voice assistants, service robots, or smart environments.

Tomorrow, they might go far beyond that:
EXOSKELETONS that not only provide support, but also multiply strength.
OPERATIONS performed from thousands of kilometers away, with the aid of robotic precision arms.
ASSISTIVE ROBOTS capable of acting on their own in nursing, industry, or space – yet guided by human sensitivity.
DIGITAL AVATARS that bring people with disabilities back into the workforce as seen at Café Dawn in Tokyo.
SYSTEMS THAT HELP – and bring joy: for example, during hiking, cycling, or therapeutic play.

Vision or soon-to-be reality?
A lot of this is already being created today – in research institutes, start-ups, and by maxon customers. Day by day, the boundary between science fiction and real life becomes a little more permeable.

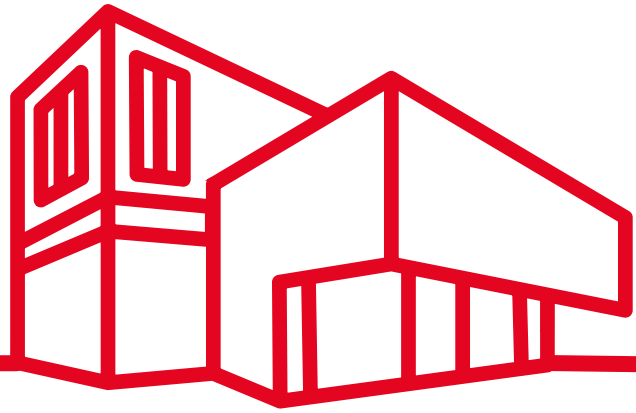
Obstacles on the road to accessibility

Well-intentioned – but often overrated. Many assistive systems sound promising but turn out to be impractical in everyday life. Why is that? According to Robert Riener, the issues are technical obstacles, high prices, difficult operation, and, above all, barriers in people's minds. As the creator of the Cybathlon, he keeps an eye on the latest technology trends and offers his perspective (without claiming to be exhaustive).

Written down by Katharina Rilling

Stairs

Elevators and stairlifts are traditional tools for overcoming differences in height. But they have their weaknesses: elevators often break down, stairlifts are slow – and when both are missing, people with impairments have to rely on others for help. That's why new solutions are being researched: For example, wheelchairs that can go up and down stairs. It's a promising technology – but not everyone who struggles with stairs opts for a motorized wheelchair for everyday use. Especially older people who can still get around on their own usually require help only in specific situations. High-tech wheelchairs could be made available in public spaces at key locations – much like e-bikes. This concept has already been successfully tested in museums in Zurich. Even small adjustments help: for people with leg prostheses, having handrails on both sides is crucial – depending on which side the prosthetic is located. A future solution could be lightweight exoskeletons, which are currently gradually entering the market. The vision: devices you can wear all day – and that make wheelchairs unnecessary. In practice, though, the technology isn't as advanced as many assume. The components – motors, sensors, materials – are well developed. What we still lack is a complete solution: can the device be put on and taken off without assistance? Is it intuitive to use, comfortable, and reliable?"



Complex building layouts

"In large, confusing buildings like hospitals or universities, it's easy to get lost – especially for blind people or those with cognitive impairments, this poses a real challenge. That's why ETH Zurich, Switzerland's leading technical university, installed an internal navigation system: in almost all rooms and hallways, small transmitters create a satellite-like navigation system inside the building. It works independently of GPS, which often can't be received inside buildings, and thus provides essential help for finding, say, the right lecture hall."

Doors

"A doorknob is much harder to use than a standard door handle. Especially in public buildings, heavy outside doors often require a lot of strength – a problem for older adults or those using walking aids. Users of wheelchairs, motorized or not, must be highly skilled to maneuver the wheelchair and open a heavy door at the same time. Some individuals additionally have a robotic arm attached to the wheelchair; others have prosthetic arms. Both require patience and practice. Modern prostheses use motors, but controlling them isn't simple. By voice command? Joystick? Torso muscle movements? Many things are possible in theory, but nothing works reliably so far.

Brain-control projects in particular fire the imagination: electrodes implanted directly into the brain to trigger prosthetic movements. But how many people would agree to have their skull opened – especially since these systems are often unreliable and prone to failure? Another option is caps fitted with roughly 40 electrodes, though they're impractical, particularly in hot weather, and still lack accuracy. If a hand fails to open one out of every three times, it's frustrating. Aesthetically, these solutions aren't appealing either. I can't name a single person who uses a high-tech prosthetic all day, every day.

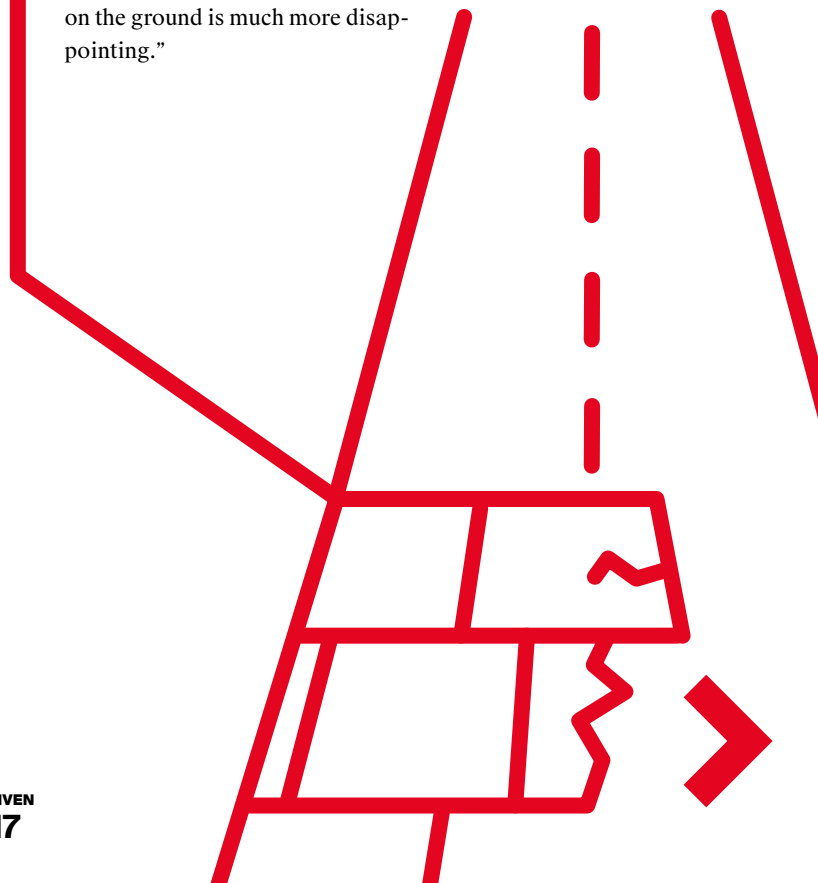
My conclusion: rather than placing too much hope in human-machine interfaces, we should focus on making the environment smarter. In the US, more doors open automatically via sensors, making life much easier. A possible idea is a simple retrofit system for existing doors. One thing I don't believe: that in the near future, people will willingly undergo brain surgery just to make a prosthesis slightly easier to use. The benefit is too small, and the effort, cost, and risks are too great."

Street surfaces

"I designed an exhibit at the ETH where students, researchers, and visitors could sit in a wheelchair themselves. Everyone noticed right away: even the smallest edges are hard to overcome – and take a huge amount of energy. Motorized wheelchairs are bulkier, heavier, and more expensive, and are therefore used only in special cases, for example for patients with extensive paralysis.

Poor ground conditions are also a big problem for people with prostheses, especially older ones. Many hardly dare to step outside, for fear of falling. Seemingly small obstacles can have severe consequences. Powered leg prostheses using artificial intelligence could one day help, even with climbing stairs. These systems need powerful batteries that last all day – and that's exactly where they've failed so far. Safety is also a major problem. Sensors, software, and controls often respond too late or incorrectly. AI is already in use today, but even a tiny control error while walking can be dangerous. With 10,000 steps each day, minor error rates can quickly turn into major dangers.

Going forward, we must address two key areas: First, infrastructure: improving surfaces, using ramps instead of thresholds, and putting thought into elevators and stairlifts. Secondly, technology. On social media you see dazzling prototypes dancing across the feeds, but the truth on the ground is much more disappointing."



Orientation without all senses

Blindness

"Reading text aloud, describing images, recognizing speech – many smartphones today are indispensable aids for blind and visually impaired people. Progress here is usually gradual: better cameras, more sensitive input devices, and more precise algorithms. True revolutions are rare, yet the benefits steadily and noticeably increase. With Artificial Intelligence, it gets interesting: canes for the blind sense obstacles and alert the users with sound or vibration. The first smart glasses are coming out that describes what's happening in the field of view of the wearer. Some devices also analyze traffic light colors, faces, or signs. Ultrasound-based navigation aids are also being developed. Often, the problem lies not with the technology, but with the environment. An example: recently, a few of my students worked on a project with blind marathon runners at the Zurich Marathon. What was the biggest obstacle? Not the course, but the logistics at the starting line. Without personal assistance, the participants wouldn't even have been able to get there. There was too much chaos and not enough orientation. Often, it's the forethought of the healthy people that's lacking. Accessibility starts in the mind – not in the technology."

Deafness

"Hearing aids are no longer bulky devices that simply amplify ambient noise – they are increasingly becoming intelligent interfaces between humans and technology. Many models can connect directly to a smartphone, so that calls and navigation reach the ear without any detour. This noticeably improves sound quality and communication. In the future, hearing aids could automatically connect to their surroundings – for instance, to the speaker system on a tram or microphones in meeting rooms – to improve understanding despite noise or distance. Such a feature would be particularly valuable for audio-only updates such as last-minute announcements or timetable changes. The goal is not just better hearing, but better participation.
Additionally, smartphones and computers now offer efficient speech-to-text software. The text then appears in sync as subtitles on the screen."

Obstacles of assistive systems

Too expensive. Many devices are unaffordable for a lot of people, especially in countries without comprehensive cost coverage. Even in Switzerland, numerous systems are not approved or must be privately funded.

Too complicated. Operating these systems often requires technical knowledge and patience. Those hoping for an intuitive solution are often disappointed: complex interfaces, unclear controls, and a lack of training options slow down adoption in daily use, especially among the elderly or people with cognitive impairments.

Too noticeable. Whether it's a brain interface with a visible head cap or a bulky exoskeleton worn over clothing, many aids are functional but stigmatizing. The goal is to make prostheses more discreet, to create exoskeletons that are wearable under clothing, or to choose designs that look cool rather than clinical. Children, for example, want robotic arms reminiscent of Iron Man – not clunky constructions made of gray plastic.

Too rare. Many devices are developed in the USA or China and are not available in Europe at all. Or they fail due to regulatory hurdles.

Too uncomfortable. Many users report that prostheses press, chafe, or are simply unpleasant to wear. Functionality isn't just about technology: Wear comfort, skin friendliness, and ergonomics are essential. After all, who wants to wear an aid that hurts after an hour?

Photo: Thomas Egli

“I wanted to drive the development ahead”

Robert Riener, Cybathlon founder and professor for rehabilitation robotics at ETH Zurich and at the Balgrist University Hospital.

Robert Riener, why was the Cybathlon* – the international competition for everyday assistive technologies – needed?
I realized that many assistive technologies were still not robust enough and were not accepted by users. Fragile arm prostheses ultimately ended up in drawers. Knee prostheses lacked motors to assist people in climbing stairs. Wheelchairs could not climb stairs. That’s how I came up with the idea to organize an event that promotes the development of such technologies.

* Want to learn more about the Cybathlon competition? → p. 33

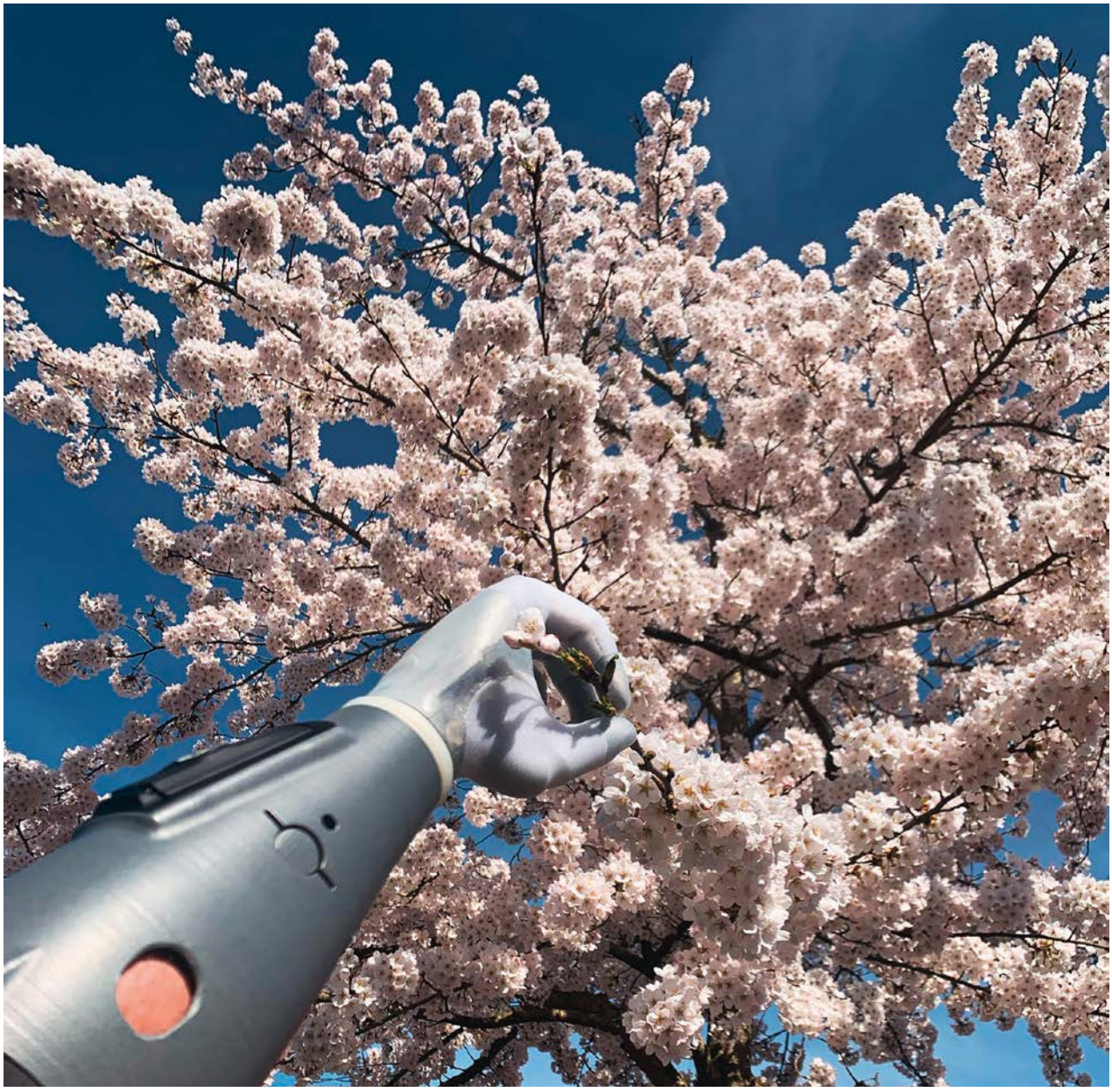
In what ways has the industry evolved since the inaugural Cybathlon in 2016?
Of course, it takes years for a new idea to progress from lab concept to finished product. However, we are now seeing the first commercial products. A knee prosthesis team that competed in the Cybathlon eight years ago is now selling its prosthesis through a spin-off in Brussels. Angel Robotics from Seoul is now also offering its products commercially. In Zurich, Scewo comes to mind, a company that has been successfully selling stair-climbing wheelchairs worldwide for several years.

What surprises you when you look at these systems?
Assistive systems are often considered technologies for people with impairments. Yet in some cases, their benefits are so compelling that even able-bodied people start using them. Take hiking with leg-assisting exoskeletons as an example. Something meant as an aid for individuals with impairments turns into an enhancement for all. Just like e-bikes, which appeal not only to people with mobility issues but also to ambitious recreational athletes. Or like low-floor trams, originally introduced for wheelchair users, but now appreciated by everyone for their convenience. The upside: Development costs decrease with greater demand, and society’s view of technical aids is changing.

What is the future of assistive technology?
We already have good individual components: powerful motors, good sensors, some even implanted. However, more work is needed to create functioning overall systems that truly help users. The technology must be easy to use, comfortable, and affordable.

What can a company like maxon contribute?
maxon provides powerful motors for exoskeletons, prostheses, and robots. Networking and bringing teams together is also highly valuable.

What’s next for the Cybathlon?
We aim to keep growing until 2028 and to invite more teams, including from Asia and Australia. This will improve global access to the technology.



Technology in full bloom

When high-tech becomes intuitive:
Adam's Hand shows how prosthetics can transform daily life and the future – powered by maxon.

Photos: BionIT Labs

Text: Janine Radlingmayr

It's a warm day in Italy. Salvatore De Cillis is working in the garden of his home near Lecce – he picks up the shovel, holding the plants steady. He does not take these movements for granted. Eight years ago, an accident cost him his left hand. Shortly after surgery, he met young engineer Giovanni Zappatore from Poggiardo, a small town in Salento not far from his home.

Back then, Giovanni Zappatore had only a screwdriver, a 3D printer, and a project: Adam's Hand. "He wanted to file for a patent soon," De Cillis remembers. He became Zappatore's first upper-limb user to test Adam's Hand. "Before that, I had tried many different prosthetic hands," he says. They had all been too complicated. Adam's Hand, on the other hand, works with only two basic muscle signals: one for opening, one for closing.

Two signals, countless possibilities

In the small lab of the young company BionIT Labs, founded by Giovanni Zappatore, the first prototype of Adam's Hand was created in 2018, driven by the idea of making highly complex technology as accessible and intuitive as possible. "The starting point was a simple but important observation," says Zappatore. "People with disabilities still have to adapt to conditions not designed for their needs. We wanted to reverse that, by building a hand that adapts to the person, not the other way around." To be more exact: Adam's Hand seamlessly adapts to each user's muscle tone, thanks to personalized calibrations powered by an advanced AI algorithm developed in-house.

Users can master Adam's Hand in just a few minutes, due to the combination of smart mechanics and integrated artificial intelligence. Adam's Hand combines easy control with the intelligent electronics of highly complex myoelectric prosthetic hands. Depending on the thumb's position, which can be passively moved into three different positions – and the orientation of the prosthesis in space, the dual-motor Adam's Hand automatically adjusts its grip pattern, offering a highly intuitive user experience. The Fully-Adaptive Grip Technology allows the Adam's Hand to automatically adapt to the shape and size of the grasped objects. This reduces both cognitive load and muscle fatigue – two of the main reasons why many conventional prostheses go unused in daily life. Users of modern hand prostheses often give them up after a short time because they are too complex, fragile, or impractical for everyday use.

In 2023, Adam's Hand reached market readiness and was launched in its Medium version across several European countries. In 2024 it was also launched in North America. Since then, the prosthesis has proven itself. The key to its success lies in practical details that make a difference in daily live: intuitive control, outstanding durability and high reliability. Those who rely on a prosthesis need a device that works without constant maintenance and remains functional even when heavily used.

From the lab to the podium

Over the subsequent years, Adam's Hand advanced steadily, ultimately standing on the podium of the Cybathlon, the international competition for users of assistive devices (see page 32). For BionIT Labs, the event is a stress test, side by side with the people who actually use prostheses. In both the 2023 and 2024 Challenges, as well as in the final round, the team reached the podium with Adam's Hand. One of them: Salvatore De Cillis. In both years, he demonstrated the impressive everyday feats he could accomplish thanks to his Adam's Hand. From working with hammers and screwdrivers to zipping: he secured third

"We wanted to build a hand that adapts to humans. Not the other way around."
Giovanni Zappatore, CEO BionIT Labs

Giovanni Zappatore is driven by the idea of making highly complex technology accessible and natural.

Viviana Lucarini lost all four limbs and today puts her trust in the small version of the prostheses from BionIT Labs.

Works not only in the lab but also under pressure: Adam's Hand at the 2024 Cybathlon with pilots Salvatore De Cillis (top and right image) and Philipp Barluschke (bottom).

place in both 2023 and 2024. In 2024, Philipp Barluschke took first place with the prosthesis. "We were able to prove that the prosthesis functions in real-world conditions, not just in the lab," emphasizes engineer Zappatore. These wins validated the team's work and goal: developing practical, user-focused solutions that truly assist people.

Well-handled: development, precision and reliability

In January 2025, Adam's Hand Small was introduced, a more compact, faster, and even more durable version, ideal for younger users and women. Viviana Lucarini, one of BionIT Labs' ambassadors, also benefits from the Small version. After losing all four limbs, she regained confidence and autonomy with two Adam's Hand Small prostheses.

Adam's Hand Small is 15 percent lighter (485 g instead of 570 g), performs movements 10 percent faster, and includes additional technical improvements for greater durability. Some of these improvements, such as the increased speed, are also available as a software update for the Medium version.

The heart of the prosthesis remains its precise and durable drive technology. "Reliability is absolutely crucial for a device like Adam's Hand," says Zappatore. "Especially for users with bilateral hand loss, the prosthesis must function in daily life without compromise." This is where the partnership with maxon comes into play: maxon's highly precise, compact, and durable motors provide a powerful grip while having a low weight, and ensure reliable, low-maintenance operation.

"In addition to the technical quality, we value maxon's flexibility and willingness to collaborate," says Zappatore. "Especially in our highly specialized field, we need a partner who addresses our specific needs and actively supports our international growth."

Stagnation is not an option at BionIT Labs. The team is already working on further innovations: customizable controls, smart sensors, and even lighter designs. In the future, users will be able to operate their hand prostheses with even greater ease and accuracy. International expansion is also being advanced. One priority always stays in focus: close communication with the users. "Only by taking their feedback seriously can we truly improve the prosthesis," emphasizes Zappatore.

Learn more

Photos: BionIT Labs

From wood to high-tech: The history of prosthetics

Prostheses evolved from simple replacements to intelligent parts of the body. A look at how they changed thanks to technology and design.

9th – 6th century BCE

A large toe made of leather and wood: the oldest preserved artificial body part comes from Egypt. It helped the wealthy wearer conceal a physical flaw.

5th century BCE

The Greek historian Herodotus mentions a man named Hegesistratus, who is said to have amputated his shackled lower leg while in Spartan captivity. Afterwards, he was provided with a wooden prosthetic foot.

3rd century BCE

Marcus Sergius Silus, a rich Roman general, is among the best-known prosthesis users of ancient times. After losing his hand in the Second Punic War, it was replaced with an artificial one made of iron, enabling him to hold his shield again.

Medieval period

People with deformed limbs due to leprosy are a common sight. They often make do with simple wooden boards and basic stumps.

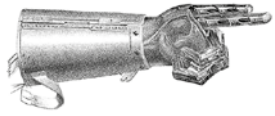
15th century

This "Florentine Hand" from the second half of the 15th century is the oldest known iron hand. At 840 g, it is quite heavy.

16th century

Skilled artisans begin creating prosthetic devices. For example, the French surgeon Ambroise Paré. He introduces new methods, like tying off damaged blood vessels, and creates artistic prostheses. The prosthetic legs he made from wood, leather, iron, and copper could lock at the knee.

1812



Peter Baliff, a surgical technician from Berlin, creates an arm prosthetic operated with cable pulls at the elbow and shoulder. It is the first prosthesis that can be moved without the help of the healthy hand, marking the birth of the modern arm prosthesis. However, amputations were still carried out without any anesthesia. Medical anesthesia was only introduced in 1846.

from 1861

The industrialization of warfare leads to prostheses being refined and mass-produced. Roughly 60,000 amputations occurred during the U.S. Civil War (1861–1865), leading to prostheses that were more comfortable to wear and more affordable.

1916

A turning point: Ferdinand Sauerbruch, a surgeon at Zurich Cantonal Hospital, invents the active prosthetic. Nearly three decades later, the most famous patient fitted with a Sauerbruch arm was Claus Schenk Graf von Stauffenberg, known for attempting to assassinate Hitler.

20th century

Different prostheses for all body parts enter the market: bone implants, metal bone segments, artificial veins, artificial hip joints, and cochlear implants that allow deaf people to hear again.

Today

Bionic prostheses that can be controlled by thought are being developed. Electrodes transmit muscle signals to electric motors. Efforts are underway to link prostheses directly to the nervous system.
This would allow the sense of touch to be restored.

Future

The high-tech prostheses of the 21st century are not the end of the road. Scientists in stem cell research are exploring prosthetic gene therapies, with the aim of growing and replacing limbs to enhance humans.

Operation Future

A delicate stitch with needle and thread: In the operating room, the Dexter robot gets to work on the human body. It is controlled by surgeons, complementing their expertise with superhuman precision, dexterity, and steadiness.

Text: Katharina Rilling

Inside hospital operating rooms, a silent assistant stands ready. It never trembles, needs no breaks, and shows no signs of fatigue even after working many hours. Its name is Dexter. The surgical robot, developed by the Lausanne-based company Distalmotion, stays in the background and is designed to complement, not replace, the human hand. It is part of a new generation of medical assistive systems: compact and versatile. Dexter is used in laparoscopic procedures: "keyhole" surgeries performed through a few small openings in the abdominal cavity. The robot manipulates instruments with millimeter precision – controlled from a console where surgeons operate pedals and precision handles. An articulated tip on the instruments provides extra freedom of movement, especially useful for suturing or delicate tissue manipulation.

Made for everyday use in the operating room

A key feature of Dexter is that it's built for the realities of daily clinical practice. The system is easy to set up or dismantle and has an exceptionally small footprint. This makes it suitable even for smaller clinics with limited resources. In addition, the system allows flexible switching between robotic and manual operation, which not only enhances safety but also improves the learning curve for trainee surgeons. "The demand for flexible, cost-efficient, and ergonomic operating systems is growing – Dexter fits the bill perfectly," notes Dario Renggli, Business Development Engineer at maxon. The technology behind Dexter is built on drive systems engineered especially for sterile environments. The core element of the robotic arms are maxon electric motors, ensuring exact, consistent motion.

"The drive system must enable highly precise movements, especially during minimally invasive procedures. It also has to be modular and compact so it can be integrated into existing operating room infrastructures," Renggli explains.

More and more clinics are turning to robotic assistive systems like Dexter. The benefits are measured not only in economic terms, but also in the long-term advancement of surgical standards and improvement of working conditions in the operating room. The human being stays indispensable – as the one who thinks, decides, and feels – while the machine adds its precision and stamina. Together, they form a team that sets new benchmarks in modern medicine.

"We chose maxon because of their proven expertise in high-performance drive solutions and their ability to adapt designs to specific requirements. What impressed us most was the possibility to achieve precise movements in a compact design."

Benazir Premji, Global Marketing Director of Distalmotion

Learn more

Photos: Distalmotion

Surgical Assistive Systems at a Glance

Distalmotion

Distalmotion is a global medical technology Swiss-based global whose mission is to make robotic surgery more accessible by simplifying operations with its DEXTER robot. The company aims to expand access to robotic surgery for more surgeons and healthcare facilities worldwide, including outpatient hospital departments and same-day surgical centers, to increase the number of patients benefiting from top-tier minimally invasive care. Thanks to its small size and high mobility, DEXTER can be integrated into operating rooms of any size without modifications and can be moved easily between rooms. This creates greater efficiency. The sterile console supports flexible surgical workflows by placing the surgeon close to the patient for quick access to the operating table, enabling seamless transitions between laparoscopic and robotic methods as needed, and improving communication with the operating team.

MIRA – Robotic surgery from afar

What if a surgical robot could be operated remotely and still fit into a suitcase? MIRA, developed by the US startup Virtual Incision, is exactly that: a robot-assisted system inserted through a single abdominal incision – without external robotic arms and without major installation requirements. The compact arm is anchored directly to the operating table and performs work inside the body. To move it, maxon ECX SPEED 6 and 8 mm motors are used.

Its intended use is for colorectal surgeries, in other words procedures on the large and rectal intestines – a delicate yet common surgical field. MIRA is intended for locations with limited space, staff, and infrastructure: rural clinics, mobile units, space stations. It is operated via a console, allowing remote use across great distances.

NASA is already testing the system for use in zero gravity. A robust robot for environments where autonomy during surgery – even from a great distance – is crucial. MIRA received US market approval in February 2024.

More information on the maxon blog

Da Vinci – How robotics became part of everyday surgery

When Intuitive Surgical launched the first Da Vinci robot in the early 2000s, the idea was revolutionary: a system translating human movements into ultra-precise surgical procedures. It is now widespread, with over 9,500 units in use around the world. For many hospitals, Da Vinci is not just a tool but also a symbol of advanced surgery. The surgeon sits at a control console while the robotic arms – attached externally to the patient – operate with millimeter precision. The system is especially well-established in urological, gynecological, and abdominal procedures. Last but not least, Da Vinci is also an assistive system in the truest sense: It enhances the senses, stabilizes the hand, and filters tremors. A complete Da Vinci system contains over 100 motors, distributed across the console, robotic arms, instrument guides, and camera control. Depending on the model, up to 39 maxon motors are used.

More information on the maxon blog

Hugo RAS – Assistant in the connected operating room

Robotic arms that deliver data. Image analyses that enhance procedures. Cloud platforms that standardize surgical workflows worldwide. With Hugo, Medtronic has developed not just a modular operating system, but a digital ecosystem. The robotic arms can be positioned individually around the operating table, which is especially advantageous in cramped hospital environments. At the same time, the system streams anonymized video data to a central analysis tool. Thus, each operation generates a dataset that makes surgical knowledge scalable over the long term. Hugo's concept of assistance is not to be an extension of the hand, but rather part of a learning complete system. It is approved for use in both the USA and Europe.

MPS Hexapod – when every micrometer counts

In the world of surgery, even the smallest gesture often matters – literally. The Hexapod from Micro Precision Systems SA (MPS) in Switzerland functions where other systems reach their limits. Six linearly actuated legs support a platform that can be fine-tuned in all directions, offering low-vibration and high stability and precision. With a size – or rather compactness – of about 5x8 centimeters and a weight of 330 g. The hexapod is used in neurosurgery, ophthalmology, or catheter procedures. It is not a standalone surgical robot, but a precise component integrated into larger systems or specialized solutions. Developed and manufactured in Switzerland, available worldwide through OEM partnerships. A form of technical support that remains almost unnoticed – yet is highly effective.

When technology walks alongside you in daily life: A wearable robot for on-the-go

Walking without getting tired: Korean start-up WIRobotics has developed WIM, a wearable exosuit that makes walking less strenuous. Target group: everyone – the new e-bike of sporting equipment?

Text: Urs-Ueli Schorno

For many, walking is difficult, due to age, past injuries, or chronic illnesses. A Korean start-up wants to address this issue. WIRobotics has developed WIM, a wearable exosuit that assists with walking. The key design requirement: it is lightweight, inconspicuous, and suitable for daily use.

Photos: WIROBOTICS CO., LTD.

Perhaps soon commonplace in the Swiss mountains? The lightweight exosuit almost looks stylish.

WIM is a compact walking aid that supports leg movement via a cable-driven system. A single motor from moves both legs simultaneously, providing subtle but effective assistance for walking. The aim is to reduce the effort required for walking by about twenty percent.

The suit weighs less than five kilograms, can be folded, and put on in seconds. The target group isn't just older people or recovering patients, but anyone who wants to stay active – whether strolling, hiking, or doing light exercise. According to WIRobotics, WIM was developed to "improve mobility and physical endurance" – not just in rehabilitation, but also in daily life and during leisure activities. This places WIM in a growing category of wearable assistive technologies designed for life outside hospitals and rehabilitation centers.

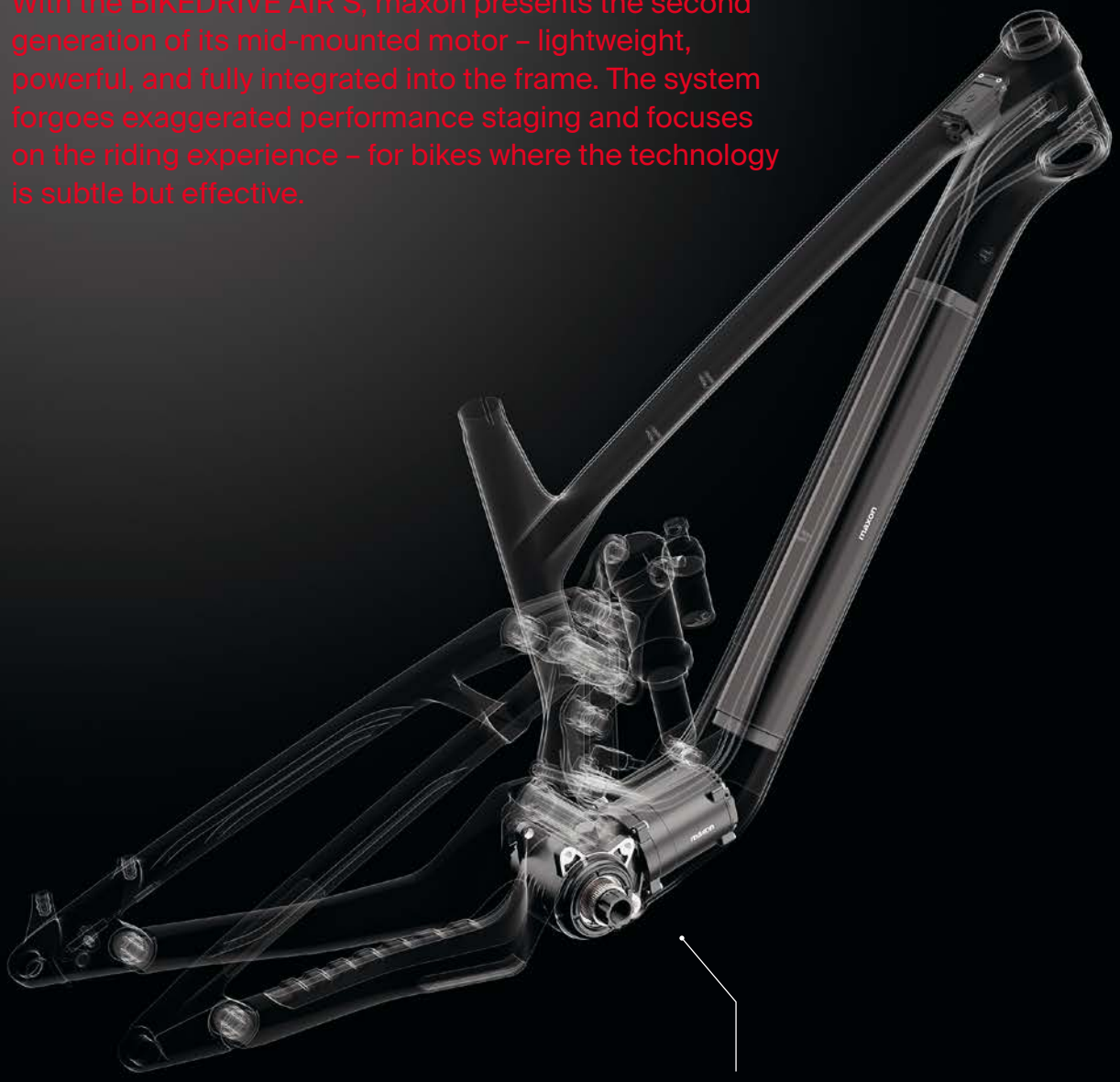
At the heart of the system is drive technology from maxon. With an EC-i series motor, maxon provides the compact, quiet, and efficient drive that powers the exosuit.

WIM represents a lightweight, intuitive robotic solution that integrates seamlessly into everyday life. In recreational settings in particular, it provides more freedom, eases physical strain, and opens up new ways to stay active. Outside of South Korea, the exosuit can currently be purchased on the American market for $2,500 USD. A market launch in Europe and Japan is planned.

EC-I MOTORS in a wearable exosuit.

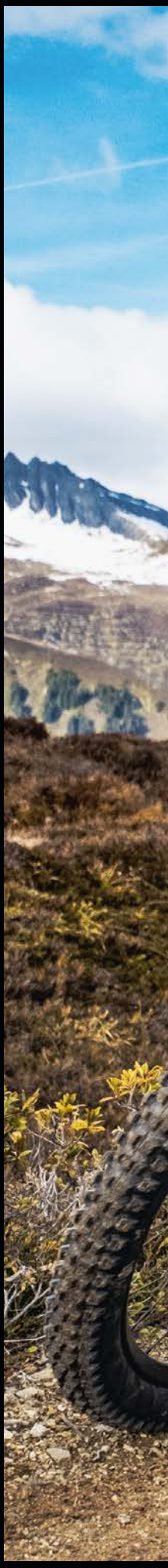
Invisible. Until you start moving.

With the BIKEDRIVE AIR S, maxon presents the second generation of its mid-mounted motor – lightweight, powerful, and fully integrated into the frame. The system forgoes exaggerated performance staging and focuses on the riding experience – for bikes where the technology is subtle but effective.



BIKEDRIVE AIR S
An overview

Torque: 90 Nm
Motor weight: 2 kg
Batteries: 400 / 600 Wh
+ optional Range Extender (250 Wh)
Areas of application: Trail, Gravel, Urban
Special feature: fully integrated into the frame
Development: maxon headquarters, Sachseln (CH)



Photos: maxon Group, Kifcat


DT SWISS
FOX
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DT SWISS

Text: Urs-Ueli Schorno

At first sight, the bike looks traditional – yet inside it conceals the BIKEDRIVE AIR S, a full power e-drive. And that's exactly the point. The BIKEDRIVE AIR S is a compact, modular system designed to integrate seamlessly into a wide range of bike concepts. From trail to gravel to urban bikes – wherever weight, integration, and ride dynamics are key.

At its core, the AIR S delivers up to 90 Nm of torque while weighing two kilograms. For bike manufacturers, this means more freedom in frame design, less complexity in system integration – and a clear focus on what really matters: the riding experience.

Power where it's needed

The drive was developed in Switzerland by maxon, using technologies proven in robotics, aerospace, and medical engineering. The result is a system that provides assistance without changing the character of the bike. "Our goal was to combine maximum power density with efficient, precise control and compact design," says Dominik Stockmann, Head of Research at maxon.

The support is noticeable but not overpowering. Nicole Tschenett, an experienced mountain bike guide, says: "I never imagined that so much power could be packed into such a lightweight system. The help is subtle yet effective – and the bike's responsiveness is fantastic."

Ride naturally – with extra options

In Disentis, Tschenett and Ralph Näf, team leader of the Thömus maxon Racing Team, tested the system in alpine terrain. Their impression: The bike is agile, responsive, and easy to control, even on challenging trails. "The bike feels light and playful," says Näf. "Not a typical E-MTB. More like a real mountain bike – just with extra power." Even on narrow trails, the system's fine-tuned performance stands out. "Especially in hairpins or narrow trails, you can feel how well the rear wheel responds," says Tschenett. The combination of low weight and strong support makes you want to do more: "more climbs, more flow, more line choices." The developers deliberately avoided abrupt bursts of power. Instead, the control system was calibrated so the motor complements your own effort – not replaces it. Technology as a companion, not as a replacement for human strength.

BIKEDRIVE AIR S
New mid-mounted motor for e-bikes

Modular, lightweight, and versatile

In addition to the drive, the system offers flexible battery options: 400 or 600 Wh and an optional 250 Wh Range Extender. In practice, the smaller option is enough for about 1,000 meters of elevation gain. The compact build makes the AIR S suitable for a wide range of frames and uses – from sporty to urban. Or whatever else the engineers might come up with. This reduces variation in development and makes the system especially attractive for brands wanting agile, independent e-bike designs. The focus is always on these three key qualities: lightweight, powerful, integrated.

Support that takes you further

Ultimately, it's the feeling of having gone further that stays with you – less effort, more enjoyment. For Tschenett, that's exactly what makes a good e-drive: noticeable when it counts, unobtrusive when it doesn't. "I went further, with more fun – and never reached that spot where you'd usually have to get off."

That was also the approach in development: creating a system that supports rather than dominates – putting the rider at the center, not the performance stats.

Presented at Eurobike – available from 2025

The AIR S was first showcased at Eurobike in Frankfurt in summer 2025. From next year, the first series models will be on the market – among them some from Brands like Thömus, Transalpes, Bikelab, Goobz, Spherik, Instinctiv, and CDuro.

Learn more about BIKEDRIVE AIR S

Photos: maxon Group; Kifcat

Includes joy

Laughing, spinning, flying – without barriers: At Morgan's Wonderland, the world's first inclusive theme park, technological aids are the key to participation. What sounds like a vision of the future is already reality in Texas.

Text: Urs-Ueli Schorno

A wheelchair-bound child laughs as they zoom down a zipline, while children with walkers, autism, or no impairments ride the carousel together. What sounds like a vision of an inclusive future is everyday life in San Antonio, Texas. Morgan's Wonderland is the world's first theme park built from the ground up for people with and without impairments. The guiding principle: Ultra-accessibility – ensuring everyone can take part.

Six million for new high-tech experiences

The park was opened in 2010 by entrepreneur Gordon Hartman, inspired by his daughter Morgan, who lives with cognitive and physical impairments. "Too often, people with impairments had to say: I wish I could. Here, it's about: You can," he says. The park features more than 25 rides and play areas, from a sensor-controlled jeep course to an interactive music zone.

The common thread among the attractions: they are designed so no one is left behind. It includes everything from an accessible theater with wheelchair spots that require no transfer, to a water playground using the PneuChair, the world's first pneumatic, waterproof wheelchair. Technology plays a central role: many controls can be operated with a push of a button, a joystick, or even eye movement. "Our aim was that no one would have to remain a mere spectator – everyone should be part of the experience," says Richard Pretlow, the park president.

"Too often, people with impairments had to say: I wish I could. Here, it's about: you can."

Company owner Gordon Hartman (pictured with his daughter Morgan)

Visitors with sensory impairments can find protected zones where volume, light intensity, and interaction can be individually adjusted. Even boarding and exiting rides is made fully accessible.

In 2025, the park invested around six million dollars in new high-tech experiences. This includes a 13-story zipline and a 4D cinema with a movable wheelchair platform. Existing attractions were upgraded with new technology. From 2026, the park will include an inclusive hotel featuring AI concierge services, voice activation, and full digital accessibility.

Morgan's Wonderland represents an inspiring type of assistance: here, technology not only assists with everyday tasks but also enables people to experience moments of independence.

Photos: Morgan's

What remains?

What impact does the Cybathlon truly have? The editorial team of maxon driven was on site, speaking with pilots and engineers about it. Three selected voices are featured on these pages, all full video interviews are available online.

Jessica Dibady
Pilot RISE / TU Berlin

“I’m thrilled with the technology here. The Cybathlon is a huge party full of innovation for many forms of impairment. I feel that too few people with impairments are seen in everyday life. That’s why events like this are extremely important. I have only been paralyzed for five years, which means I know life before and after – and the everyday challenges. I have lost a lot of autonomy and sometimes try to regain it through various assistive technologies. Just being here or having the chance to use a device like an exoskeleton opens a window to the future – I can see how I could truly improve my daily life.

Jessica Dibady, pilot of Team Rise, exoskeleton race

Nicolas Huchet
Pilot of Bionicohand / France

“My impairment plays a real role in this project because I can give engineers direct feedback regarding the prosthesis. Just two in ten people with hand amputations make use of prosthetic hands. Why? Up until now, they have been hardly affordable. For prosthetics to gain acceptance, they need to be lightweight, aesthetically pleasing, user-friendly, and robust. One thinks: the more technology, the better life is – but that is not true. It’s about providing people with access.”

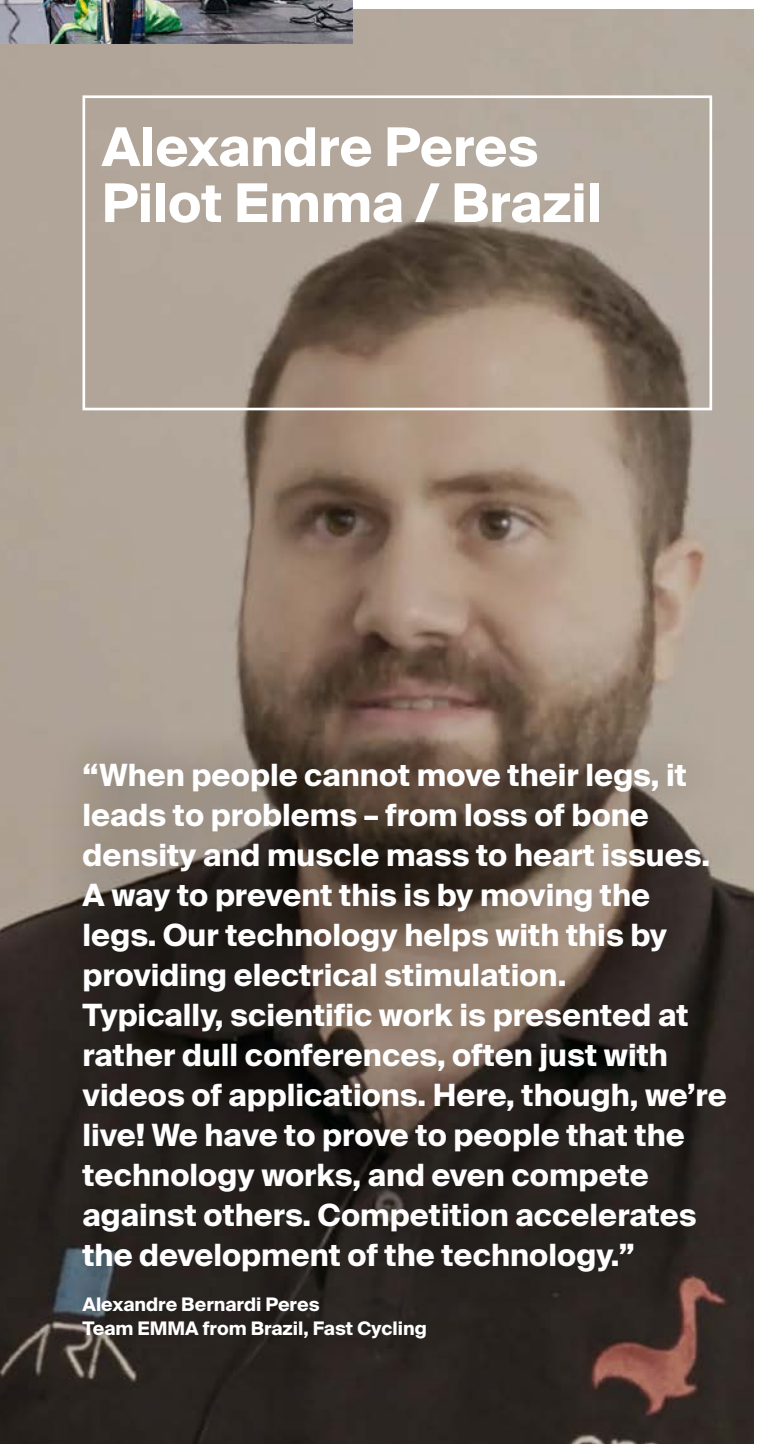
Nicolas Huchet, pilot Team Bionicohand, arm prosthetics race

THE FULL PICTURE!?
We spoke with these participants and many other pilots and developers. Watch all videos now

Off to the future!

CYBATHLON was created in 2013 by Professor Robert Riener at ETH Zurich to provide a platform challenging teams from around the world to develop practical assistive systems for and together with people with disabilities. The vision behind CYBATHLON is to advance assistive system innovations and foster inclusion of people with disabilities.
In 2024, 67 teams from 24 countries took part in CYBATHLON, competing across eight disciplines at the SWISS Arena in Kloten, Switzerland, and simultaneously at seven connected hubs in the USA, Canada, South Africa, Hungary, Thailand, and two in Korea. The CYBATHLON has now come to an end as a project at ETH Zurich, but it remains as a lasting global platform for innovation and inclusion. The next edition of CYBATHLON could take place in Asia in 2028, opening a new chapter.

Alexandre Peres
Pilot Emma / Brazil



“When people cannot move their legs, it leads to problems – from loss of bone density and muscle mass to heart issues. A way to prevent this is by moving the legs. Our technology helps with this by providing electrical stimulation. Typically, scientific work is presented at rather dull conferences, often just with videos of applications. Here, though, we’re live! We have to prove to people that the technology works, and even compete against others. Competition accelerates the development of the technology.”

Alexandre Bernardi Peres
Team EMMA from Brazil, Fast Cycling

Well done! The winners of the Cybathlon 2024

A handful “Why?”

Good design requires questions.

1 **Why do so many assistive technologies appear to be designed for machines rather than for humans?**
The traditional development process is often focused primarily on technical functionality.

2 **Why is that a problem?**
Not all solutions that are good from a technical standpoint also feel good. And because technology may work – but it may not always work for some.

3 **Why is this so often only noticed at the end?**
Design is often considered too late in the process. Frequently, only once everything else is in place. At that point, its role is only to add an aesthetically pleasing look to the decisions that were already made.

4 **Why do many people consider design mere decoration?**
Because we’ve forgotten that design is intellectual work. That design means asking questions. Again and again.

5 **Why does this matter so much in the field of assistive technology in particular?**
Because here, it’s about more than mere efficiency. It’s about dignity. About participation. About practical usability that’s not just measured but sensed. The technology might be the backbone. But the design is the face. It decides whether someone feels seen – or diminished. Whether a wheelchair feels like a piece of sports equipment. Or like a medical relic. Indeed, sometimes changing the radius, choosing another material, or intentionally breaking conventions is what fosters acceptance. Or pride. Or both.

! **Good design needs more than questions – it endures.**
That’s why I call on everyone who creates, develops, or decides: ask yourselves more often, **“Why?”** – not once, not twice, but five times. Not out of mistrust. But out of respect. Respect for the complexity of living with technology. And for the simplicity that only arises once you understand why the technology is truly needed. ▬

Ulrich Kössl is a designer and innovation facilitator at the Swiss Paraplegic Foundation. With his interdisciplinary approach, he brings together those affected, designers, and developers – and advocates for design that not only works but empowers people. Design, he says, begins with listening – and asking “Why?” five times.

Parvalux: From Britain, with Precision

Parvalux – a company of the maxon Group – develops drive systems that enable people to live with greater independence and safety. Robust and precise, its motors ensure that stairlifts, wheelchairs and more operate quietly, powerfully and smoothly – for movements that feel natural.

Text: Urs-Ueli Schorno

Mobility is not optional. For people who rely on assistive devices in daily life, it's what enables independence, safety, and dignity. Parvalux builds the kinds of drive systems that make this possible – compact, robust, and adaptable geared motors designed for real-world use in assistive technologies.

Stairlifts, patient hoists, powered wheelchairs, mobile ramps – none of these systems work without motion that's reliable and controlled. That's where Parvalux comes in. The company has been engineering electric drive systems for over 70 years and has been part of the maxon Group since 2018. Their motors are used globally in applications that demand more than just torque and power – they need movement that feels intuitive, quiet, and safe.

"At Parvalux, we collaborate with manufacturers worldwide to create solutions tailored to their specific applications. With decades of experience prioritizing both safety and performance, we are a trusted partner in delivering reliable, customised drive systems for assistive technology," explains George Sparrow, Group Sales Manager at Parvalux.

The requirements are specific: a stairlift must handle curves, inclines, and user weight with smooth acceleration and no jolts. A patient hoist needs to lift and lower without hesitation. A wheelchair motor must balance responsiveness with energy efficiency. Across all these use cases, mechanical precision translates directly into human comfort.

Photos: Getty Images/iStockphoto

«One of our key fundamental strengths lies in safety-critical applications with often a custom or totally customised design, making us a truly trusted partner»

George Sparrow, Group Sales Manager Parvalux

Parvalux offers modular systems that can be tailored to each application – whether that means 12V battery operation, worm gear configurations, compact planetary drives, or custom mountings. Manufacturers don't get generic parts – they get motion solutions that fit.

The motors are built to last, with low maintenance needs and performance tuned for everyday use. They run quietly, integrate cleanly, and behave predictably – even under challenging conditions.

"At Parvalux, although our portfolio spans a variety of markets, one of our key fundamental strengths lies in safety-critical applications with often a custom or totally customised design, making us a truly trusted partner, " adds George Sparrow.

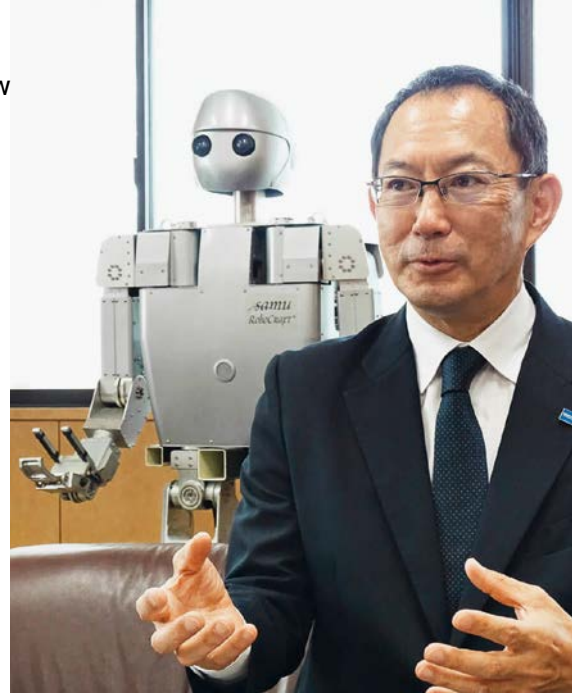
There's a kind of understated expertise in how Parvalux approaches motion – a deep familiarity with how movement needs to feel, not just function. It's the difference between knowing how to build a drive system and knowing how to move.

From Japan, the paradise for robotics

“Technology that makes people happy again”

How can technology support us – not as a replacement, but as a partner? This question motivates the Japanese robotics entrepreneur Tadahiro Kawada. In the conversation, he opens a window onto Japanese technoculture.

Photos: unsplash/ Eddi Aguirre; Alamy Stock Foto/Harshita Vectors; Alamy Stock Foto/AJ Pics, ©SONY PICTURES ENTERTAINMENT



Interview: Urs-Ueli Schorno and Sven Gallinelli

Mr. Kawada, you attended the Cybathlon – the international competition for everyday assistive technologies. What are your takeaways?

What impressed me most was how closely technology and humans collaborate as equals. Back in 2019, I attended the Cybathlon in Kawasaki, Japan, which at the time was a wheelchair competition. I especially remember one participant: a former construction worker who became paralyzed due to an accident. He was not only one of the wheelchair pilots, he was also actively involved in the development of the robotic wheelchair and provided valuable input on performance and safety. His team won first place. That was truly inspiring. I was thrilled to attend in Kloten in 2024, as the Cybathlon demonstrates how technology helps people with impairments regain their abilities. The event is a showcase for new developments in assistive technology – and perhaps even a step toward one day overcoming disability.

"I am convinced that robotics should support people, not replace them. A good example is our Tele-Barista project."

Tadahiro Kawada, Chairman of Kawada Robotics

Were there technical aspects that particularly fascinated you?

Absolutely – the event involving brain control was extremely captivating. The idea of guiding a robot with your mind deeply impressed me. The exoskeleton race and the competition for visually impaired participants were also remarkable. The Swiss teams, supported by maxon, won these competitions.

You have been involved with robotics for decades. Has the Cybathlon changed your perspective?

It mostly confirmed it. I am convinced that robotics should support, not replace, humans. A good example is our Tele-Barista project for the DAWN Avatar Robot Café Beta in Tokyo. It involved a former barista who has ALS, a neurodegenerative disease – she can no longer make coffee herself but knows exactly how good coffee

Photos: KAWADA Robotics Corporation

At the Dawn Café, the Tele-Barista serves customers – operated remotely from home.

is made. Together with her, we developed a remote-controlled system based on our NEXTAGE robot that precisely replicates her hand movements. It wasn't about efficiency but about preserving her knowledge – and giving her the chance to work as a barista again.

Your company was originally involved in heavy industry. How did robotics come into play?
Our main business was building high-rise structures and bridges, later also aviation. At the end of the 1990s, we were forced to abandon a helicopter project because of economic problems in Japan. My team turned to mechatronics – for vehicles, aerospace, and entertainment technology. In 1999, a professor from the University of Tokyo proposed developing a humanoid robot. Even though we had no experience, we said: "let's give it a try." Four months later, our first robot, the H6, was up and running. Two years later, the HRP-2 was developed – a flagship within Japan's national Humanoid Robotics Project (HRP). The expertise we gained in aviation, including lightweight design, control systems, and vibration management, could be directly applied.

Today, your robots are used worldwide. What drives you?
Japan is suffering from a severe skilled labor shortage – not just in industry. Our NEXTAGE robots now work side by side with humans, especially in production. I am convinced they will also assist in other work environments in the future. Even people with impairments can operate our robots. That enables participation. NEXTAGE doesn't replace jobs; it enables people to work and improves their earnings. Humans continue to handle complex tasks such as monitoring, maintenance, and optimization.

You have been working with maxon for many years. What do you value about this partnership?
Our first robot in 2000 used maxon drives – and we still use them in many systems today. When I visited the maxon factory in Sachseln, I was especially impressed by the people: many have been there for years. The atmosphere is personal. I never order my engineering staff to use maxon – but they do. That shows trust.

Where do you see potential for joint developments?
Everywhere fine movements matter – grasping, holding, sensing. We call this the "last mile" – though "last millimeter" is more precise. There is also enormous potential in prosthetics and robotics for everyday applications.

How far are we from robotic assistance in everyday life?
That's still quite a way off. In factories, robots operate in controlled environments. At home, there are kids, stairs, and animals. Many robots may look impressive and can

Friendly, not menacing: This is how Japan perceives the H6 (left) and HRP-2 robots.

Photos: KAWADA Robotics Corporation

“In Japan, over 25 percent of the population is over 65. We need solutions that make daily life easier and preserve dignity. Assistive technology will be central to this.”

Tadahiro Kawada, Chairman of Kawada Robotics

dance or jump. What really matters is: Are they able to stop safely, pay attention, and react? And who is liable if something goes wrong? These questions must be resolved first.

Everyday assistants need to be accepted by people. What cultural differences do you see between Japan and Europe in dealing with robots?
In Japan, robots are part of pop culture. Think of manga characters like Doraemon or Astro Boy; they are our friends. In Shintoism, even objects can have a spiritual essence. Technology is treated with respect. In Western cultures, however, the narrative of technology as a threat often dominates – like in “The Matrix” or “Terminator”. This shapes society’s perception of robots.

Where do these differences come from?
I believe religion plays a significant role. Buddhism tends to be philosophical rather than dogmatic, and Shinto holds that divinity exists in nature – be it a river, a tree, or a carefully crafted machine. That’s why it is not unusual for us to treat a machine with respect. Many Japanese grow attached to their car or a specific machine, not due to fascination with technology, but because a bond develops. This also shapes our approach to robotics.

Do you think others can learn something from this?
Maybe. It requires a shift in perspective – from asking “Is this dangerous?” to “How can it benefit us?” If we see robots as partners rather than competitors, many things become easier. But such cultural mindsets do not change overnight.

Let’s return to the topic of technology: the relationship between humans and machines – the interface – is crucial, isn’t it?
Absolutely. A system must be easy to control intuitively; otherwise, it isn’t practical for everyday use. We’re only at the start – but neural interfaces, artificial intelligence, and better sensors will result in a lot of development.

What would be the ideal form of assistive technology for you?
A system that I can control intuitively with my voice and thoughts. One that helps me stand up, move, and work. In Japan, over 25 percent of the population is over 65 years old. We need solutions that make daily life easier while preserving dignity. Assistive technology will play a decisive role.

Looking into the future – what do you hope for?
Above all, progress in haptics and sensor technology. Our hands are a marvel – they sense temperature, pressure, and texture. If we can replicate that, caregiving, household tasks, and mobility for people with impairments can be completely reimagined – supported by AI, sensors, and perhaps even quantum technology.

Was there a moment when you knew: robotics is the right path?
Actually, there were two. The first was in 1999, when our first robot walked. That’s when I knew: we can do this! The second was when the barista could work again thanks to the Tele-Barista system. To me, that was the most wonderful moment. Technology that makes people happy again – that’s exactly what it’s all about.

About Kawada Industries

Kawada Industries was founded in 1922 and is Japan’s leading company in bridge and steel construction, with decades of experience in mechanical engineering. Around the turn of the millennium, the company began developing humanoid robots. Since 2013, Kawada Robotics Corporation has been actively advancing these technologies and offers flexible, safe, and collaborative automation solutions. The current production models of the NEXTAGE series are designed to work alongside humans in industrial settings – for example, in electronics assembly or quality control.

Robots against loneliness

Here, robots brew and serve the coffee – yet inside, they have a soul. At the Dawn Café in Tokyo, people who otherwise wouldn't have access to work opportunities control avatars from their hospital beds.

Text: Katharina Rilling

Warm lighting, wooden accents, plants, whimsical garlands – and eyes glowing in pink, green, and blue, as if from another planet. Here robots glide across the floor on sensor tracks. At the Dawn Café, in Tokyo's Nihombashi business district, they greet guests, take orders, provide advice, serve food, or work the cash register. Their faces are cute, white, and smooth.

At first glance, the café looks like a meeting place for tech-savvy city dwellers. Special, but not spectacular. On a closer look, what truly sets it apart – even in robot-experienced Japan: Beyond the robotic service staff in white uniforms, there's far more than just futuristic technology. They carry a human spark – and an idea that embodies Japan's contemporary spirit and new ways of working: the body does not need to be present to participate. Rather, it's the mind that matters.

A future lab for inclusion

Let's take a step back: how can a machine be human? The so-called "OriHime" avatar robots are operated by people with severe physical or psychological restrictions who are confined to their homes or care facilities. Using cameras, microphones, and sensitive controls, they move the bot remotely and thus interact with guests. They talk to each other, they see each other. The Dawn Avatar Robot Café offers people not only an income, but also social participation and greater independence.

One of them is Masa, who suffers from spinal muscular atrophy and is almost completely paralyzed. "I'm bedridden," he says. "I never thought I would get to work someday. Even people like me can contribute to society." The avatars are operated via a tablet or even with eye tracking, allowing Masa to manage his robot despite his severe mobility impairment. For the so-called pilots, Dawn means working for the first time, and being seen and heard. The guests can ask questions and learn more about the person behind the robot. Conversely, the machine, thanks to its cameras and speakers, serves as a gateway to the outside world – against loneliness, against silence.

It is similar for Naoki. After being diagnosed, he had to stop working from one day to the next. "The only option I have is a heart transplant," he says in a video on the café's website. "I had completely withdrawn into my shell. Now I was finally able to participate again. I really enjoy my days with the guests. It's like my feelings have been transplanted! Everything feels better." For Kotonoha, who has mental health issues, the café is currently the only place where she can

Hello! One of the cute robots called "OriHime."

Photos: DAWN CAFE; Image by tohamina on Freepik

actively contribute: “I have lost my self-confidence and can barely leave my apartment. At Dawn, people encourage me and tell me my English is very good."

The premises are fully wheelchair-accessible, providing space and various seating options. To make guests with special dietary restrictions, such as swallowing difficulties, feel welcome, the café provides utensils like blenders and silicone spoons. There are workspaces and events centered around accessibility.

Image and Technology: Kawada Technologies

Overcoming loneliness

Dawn – that means daybreak. The café sees itself as a place for a fresh start, new visibility, and the awakening of new possibilities. This has been made possible by Ory Laboratory, the manufacturer of the robots and operator of the café. Kentaro Yoshifuji, co-founder, has personally experienced a fresh start after dark years. He knows what loneliness feels like: in his youth, he was bedridden for years due to illness, cut off from school, friends, and everyday life. His sense of no longer belonging in any part of society intensified, along with his wish to do something about it. Not just for himself, but for all those who, like him, had become invisible. “We all want to be needed by someone, and in the same way, we need others. How can someone who cannot leave the house still work with other people?” The search for the answer became Yoshifuji’s life mission.

While still in secondary school, he created a stabilizing device for electric wheelchairs and won an award from Japan’s Ministry of Education for it. However, it was only at Waseda University, where he pursued robotics and AI, that his vision really took off. But he quickly realized: AI was not the right direction for him. “It should be humans alleviating others’ loneliness – not a computer program,” he was convinced. That’s why none of his products are based on AI, which is surprising in this era of AI hype. The robots? For him, they serve only as a link between people and the real world. Today, Yoshifuji intentionally designs his bots so they emit a friendly glow, can be looked in the face, spoken to, and even touched.

Masa is almost completely paralyzed and never thought he could work.

The applications of the Ory robots extend far beyond the café: children who cannot attend school due to illness can participate in classes via an avatar. And special moments – weddings, birthdays, or family gatherings – can be experienced even if one is in a hospital or care home.

Might we see something like this in Switzerland in the near future? The development shows that the idea is fundamentally viable: what started as a temporary experiment in 2018 was made permanent in 2021, and in 2024, the robots even welcomed guests at the government booth during the G7 Summit in Hiroshima. How this model develops further depends on how willing we are to rethink our old ideas – and to separate body and mind from time to time, against conventional thinking. ▬

Japan

The tyranny of the norm – and how it’s crumbling

Those who want to belong must conform to what’s normal – Japan long saw itself as a homogeneous society. Many people in this East Asian island nation still suffer under the pressure of societal expectations, which the NZZ, a Swiss newspaper, aptly calls the “*tyranny of the norms*.” Girls and women who conform to the ideal of slenderness. Men who prefer not to have a beard or long hair, or to get tattoos, because tattoos are associated with crime. People with disabilities were long particularly marginalized in Japan – more so than in many other liberal societies. Between 1948 and 1990, around 16,500 people with disabilities were forcibly sterilized – including children. It took decades before reflection and awareness initiated a shift in societal values. A symbol of this change: the 2021 Olympic Games. “Unity in Diversity” was one of the messages. The atmosphere at the Paralympics was even more enthusiastic than during the Olympic Games. It’s noticeable: over the past few years, a new consciousness has emerged recognizing the value of diversity. At least in Japan, the perception of people with disabilities has never been this positive before.

REHABILITATION AND TRAINING

From underwater to outer space

Rehabilitation, sports or space: Swissrehamed's robotic training system strengthens muscles and coordination. maxon supplies the drive system – customizable, waterproof, and soon ready for orbit

Kim Zimmermann
Sales Application Engineer, maxon

The demands on modern assistive systems are rising rapidly, be it in neurorehabilitation, elite sports, or space exploration. It's not just about performance, but also about adaptability, precision, and interaction. As a sales application engineer at maxon, I accompany such systems from concept to implementation, together with customers who are bridging research and practical use.

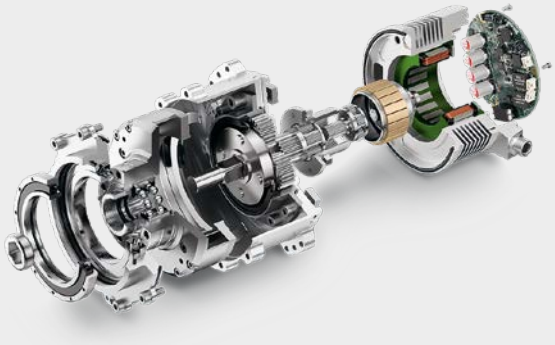
One of these projects is being developed in collaboration with the Swiss company Swissrehamed. The application is a modular robotic training system with drives that can be individually controlled, enabling personalized movement programs in rehabilitation, sports, and space exploration. The device is engineered to function even underwater – for strain relief, temperature regulation, and precise movement therapy, especially for neurological conditions or during intense training sessions.

Understanding human movement

The challenge: weightless conditions on the ISS, back training for astronauts, or mobility impairments in daily life: assistive systems reach their limits where humans act intuitively – when thinking, feeling, and reacting combine. Many existing systems are either purely mechanical, without sensory feedback, or overly complex and difficult to operate. The person becomes a passive user instead of an active designer. Furthermore, many systems lack customization. Rigid algorithms provide inadequate results for complex medical conditions. Regulatory hurdles also complicate clinical integration.

Photos: NASA / JSC; maxon Group

The High-Efficiency Joint is an innovative actuator for robotics applications.



“Swissrehamed is a company that relies on knowledge – with internationally leading experts who embody our principles in everyday practice.”

Joeri Gredig, CEO Swissrehamed

A systematic solution

At maxon, we are tasked with creating a drive system for Swissrehamed that addresses these challenges. It’s about integrating the battery, actuators, and control system. For this, we take products from our catalog and customize them specifically for the application, ensuring compatibility with the clinical setting in which they will be used in the future.

We quickly identified the core element of the solution in our portfolio: the High-Efficiency Joint (HEJ) – a new, compact, highly dynamic actuator with integrated control, modern EtherCAT interface, and IP67 protection class. It allows complex motion patterns to be controlled in real time, with high power density and maximum robustness. Even underwater.

For Swissrehamed, we also develop specific sealing concepts and cable feedthroughs for the long-term use of actuators underwater.

“Working with maxon allows us to explore our ideas boldly, knowing they are technically feasible,” says Joeri Gredig, CEO of Swissrehamed.

The technology: three systems, one principle

Swissrehamed aims to offer solutions for different applications using a single system: cranos (Space), craPos (Sport), and ascros (Medical). This is made possible through dialog-based, human-centered robotics: all systems use independently controllable drives and actively adjustable crank pedal mechanisms. This allows personalized motion sequences for patients, astronauts, and athletes. Underwater applications not only provide strain relief, but is also used for targeted temperature regulation, especially for MS patients or sports medicine interval training.

A specific example: Astronaut Marco Sieber is to test the system during a future ISS mission. The plan is to use it within the scope of a scientifically supervised application test, validated before it is used in space. Initially, the higher-performance HEJ90 will be used; and later the smaller HEJ70, which is ideal for the limited space and weight constraints in orbit.

Why an HEJ? The answer lies in the dynamics

Robotic kinematics require drives that can switch flexibly between assistance and resistance. The EPOS controller in JPVT mode (Joint Position Velocity Torque) allows simultaneous control of torque, speed, and position. The combination of high efficiency, low mass inertia, and precise controllability creates a movement sensation essential for numerous medical and athletic uses. This is our area of focus. Movement quality is not secondary; it is the goal itself.

Technical insight: why the HEJ90 is able to provide such quick and precise control

A key factor for this performance lies in the design of the HEJ, as Mario Mauerer, Business Developer Robotics at maxon, explains: “our High Efficiency actuators, like the HEJ90, use inrunner motors, whose windings are directly encapsulated with the housing. This makes the cooling so efficient that we can continuously operate at the thermal limit. Maximum performance with consistent safety. Our gearhead expertise and the JPVT controller combine to achieve acceleration from zero to full speed in just 8 milliseconds.”

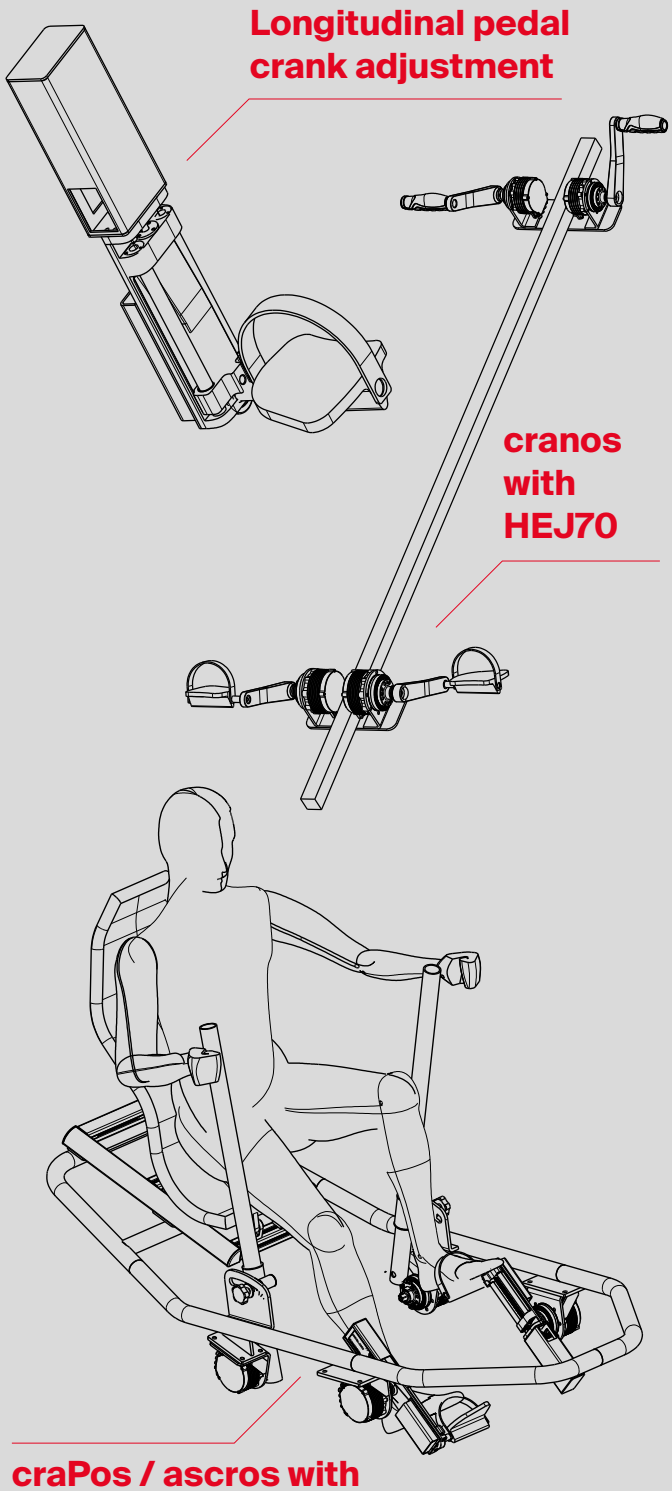
Technical highlights: underwater and wireless

In addition to the HEJ unit, the sports and medical devices feature an actively adjustable pedal crank, developed together with the Lucerne University of Applied Sciences. A brushless spindle drive ensures precise adjustment, even underwater. The biggest challenge: sealing, maintenance-free operation, and wireless energy transmission.

Our solution is based on inductive communication and wireless charging. Both are seamlessly integrated into the modular system, ensuring low maintenance, reliability, and long-term viability. Here too, we provide not just individual components but complete subsystems, ready for industrial implementation.

Design study by Swissrehamed for application in the sports sector.

How the robotic training system works



“As Swiss citizens, we strive to join Swiss astronaut Marco Sieber on his ISS mission to help tackle a significant challenge. Our vision: robotics for humans from rehabilitation to space.”

Joeri Gredig, CEO Swissrehamed

The result: a system ready for the future

The three Swissrehamed systems demonstrate how adaptable robotics can combine medical relevance with industrial quality. The personalization of intelligent assistive systems in real-world conditions is technically feasible, using a clear system architecture, reliable drive technology, and close cross-disciplinary collaboration.

The future: from rehabilitation to space

A methodical transfer framework, called the Passerelle, links technological, medical, and regulatory requirements (MDR/FDA). Systems that succeed in clinical settings can thus also be used in space, and vice versa. The first tests are being prepared, both underwater and during parabolic flights.

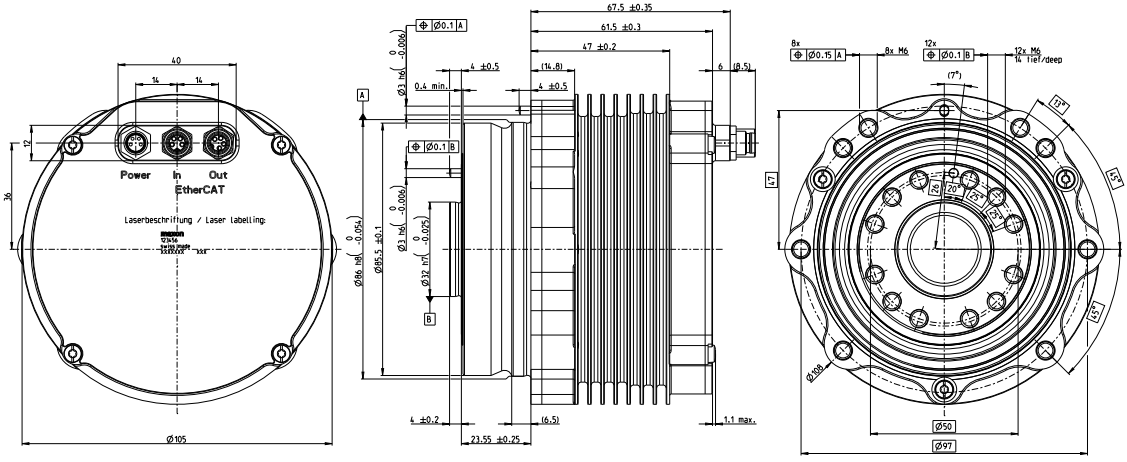
Our role: with reliable drive technology, system integration, and expertise, we create solutions that move people – on Earth and beyond.

In a nutshell: technology that is moving

As a sales application engineer, I see it as our mission to develop viable solutions with customers that go far beyond traditional product delivery. The HEJ is a good example of this. It is a building block of a system that enables individualized movement. Whether in water, rehabilitation, sports, or soon in space.

About: Kim Zimmermann

“As a Sales Application Engineer at maxon Switzerland AG, I am committed to finding and implementing the optimal drive solutions for our customers. My technical background as a mechanic and development engineer in agriculture and aerospace allows me to understand customer needs holistically and grasp technical interrelationships precisely. Over the past four years at maxon, I have had the privilege of supporting numerous customer projects – from concept phase to implementation – and contribute my expertise directly on-site.
As a result of maxon’s system-oriented approach, my responsibilities have increasingly expanded to include programming of MACS controllers for prototypes and custom applications. This versatility allows me to develop customized solutions that are compelling both technically and economically.”



Assistive technology, created by human hands

High Precision Joint

Text: Max Erick Busse-Grawitz

It is great to see how robotics has gained momentum, including in medical technology and rehabilitation. The progress is visible at the Cybathlon: the challenges the teams tackle are getting ever closer to real-life situations, and the solutions found offer greater ease of use. What's next?

The collective intelligence of people with practical experience, from research institutes, and across the value chain is indispensable. For me personally, continuous dialog with everyone involved in the design process is enriching, challenging, and therefore inspiring for collaborative problem-solving. Here the human body serves as an ideal yet unattainable model. A few examples for illustration purposes:

We replicate the agility and power density of our muscles using particularly lightweight, loss-optimized internal rotor motors and compact gearheads. To replicate the muscle's ability to sense its exerted force and relay it to the reflex chain and brain, we use a nonlinear, speed-dependent motor and gearhead model that transmits torque assessments to the higher-level controller.

The remarkably low friction in human joints can currently only be achieved with air bearings, which are expensive, energy-intensive, and bulky. A more compact and affordable solution is achievable with needle bearings in high-efficiency gearheads. We mathematically compensate for the remaining friction.

We are able to not only control the position or speed of our motion chain, but also adjust the stiffness and damping. In humans, this occurs through the interaction between muscle tension and the nonlinear behavior of cartilage. We can emulate this so-called impedance control using a combination of sensors and control algorithms that adapt well to the surrounding body's elasticity.

These descriptions illustrate some of the features of our new actuators, the High Efficiency Joints (HEJ). They are optimized for agile interaction with a partially unknown environment and respond gently to collisions.

Surgery requires a completely different approach: the focus is on precision and stiffness. Here strain wave gearheads are often used. They are somewhat rigid but inefficient, which comes at the cost of positioning accuracy and path fidelity. That's why we set out to increase stiffness and reduce friction. The result is the new GSW strain wave gearheads optimized for precision robotics, used in the robot joints called High Precision Joints (HPJ).

The articles in this magazine show one thing above all: there is a lot of creativity, a lot of innovation, and – put mildly – huge potential.

The required further developments do not occur in a vacuum. They grow from experience, collaboration, and honest dialog with reality. You, dear readers, are the ones inspiring us: as users, researchers, developers, and critical companions. For that, I am deeply grateful – and full of anticipation for what we can achieve together.

Max Erick Busse-Grawitz is head of technology transfer at maxon international ltd. His focus areas are partnerships with start-ups and academic institutions, technology assessment, and turning ideas into tangible innovation projects.

Photos: maxon Group

Braille display – a device with many faces

Text: Laura Kirschner, intern at maxon

My name is Laura Kirschner, I'm 25 years old, and I'm doing an internship in maxon's communications division in March 2025. Born completely blind, I depend on assistive technology in a wide range of situations. The Braille display is one of my key tools, and I'll explain more about it shortly.

What is a Braille display?

In short: it is a tool that makes on-screen text tactile, whether it's from a computer, phone, or tablet. That might sound simple. In reality, it isn't. Behind this seemingly simple idea lies highly complex technology. Precision, ergonomics, and everyday usability must all come together – and that's not a given. I've been using a Braille display daily for over 15 years. The one I use has 40 cells, meaning: It can fit 40 characters – including spaces – on one line without me having to scroll.

What does that mean in everyday life?

The reading space is limited – which sometimes slows my work. A quick mental exercise: imagine if your monitor could only show 40 characters. For anything more, you'd have to actively "scroll onward." Chances are, you'd hit your limits quickly.

What alternatives are available?

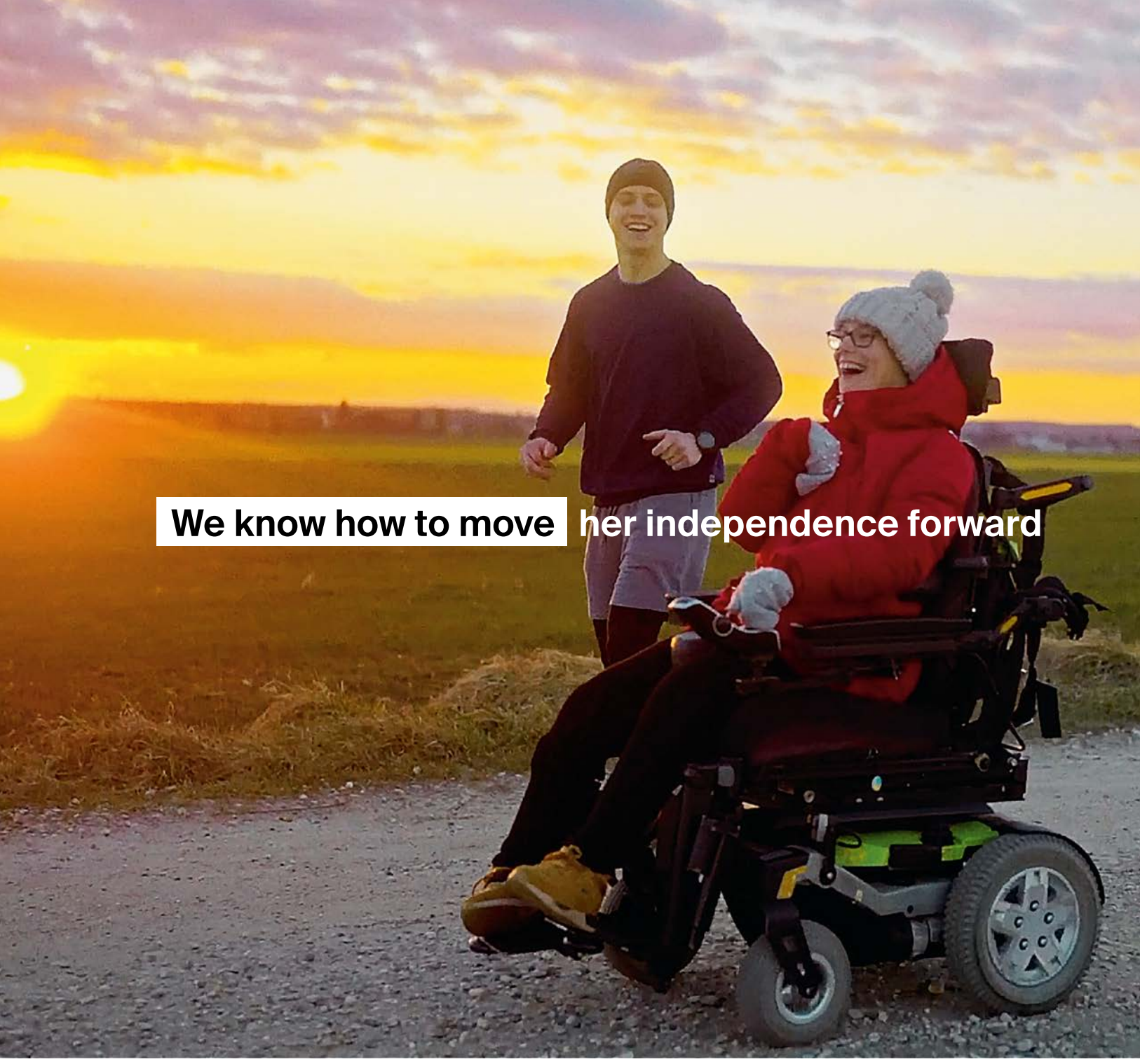
One option is voice output. A PC that can recognize a Braille display is always equipped with a screen-reading program like JAWS, ZoomText, or Fusion. With it, you can take in a lot – but not everything. Typos often go unnoticed because audio feedback isn't always precise enough. With a Braille display, I can also navigate more accurately – for example, move to a single letter within a word. That's why, for me, it remains indispensable, even when paired with speech output.

There are, however, also versions with 80 cells. They're more practical and offer a better overview – but they're also significantly bigger and heavier. Another way to fit more content on a single line is using Braille shorthand. It saves space but requires very strong reading skills, which not every blind person possesses, i see x th way too - mks se? (Can you read this sentence, for example?) An idea I have for these issues: a flexible Braille display, like a roll-up rubber keyboard, that shows the entire screen. That way, you could read more text without the device taking up too much space.

Is that realistic, or just wishful thinking? Hopefully, some inventive engineer knows the answer.

Laura Kirschner started a six-month communications internship at maxon in March 2025. Blind since birth, she uses assistive technology in her work. Previously, she studied Applied Linguistics at ZHAW.

Photo: maxon group, Illustratration: Image generated by Midjourney/ Peter kruppa



Reliable geared motors for industrial applications.
Also suitable for electric wheelchairs.

parvalux
by maxon

“

What technology can achieve rarely reveals itself in grand words, but rather in the everyday moments.

”

Eugen Elmiger, CEO of the maxon Group