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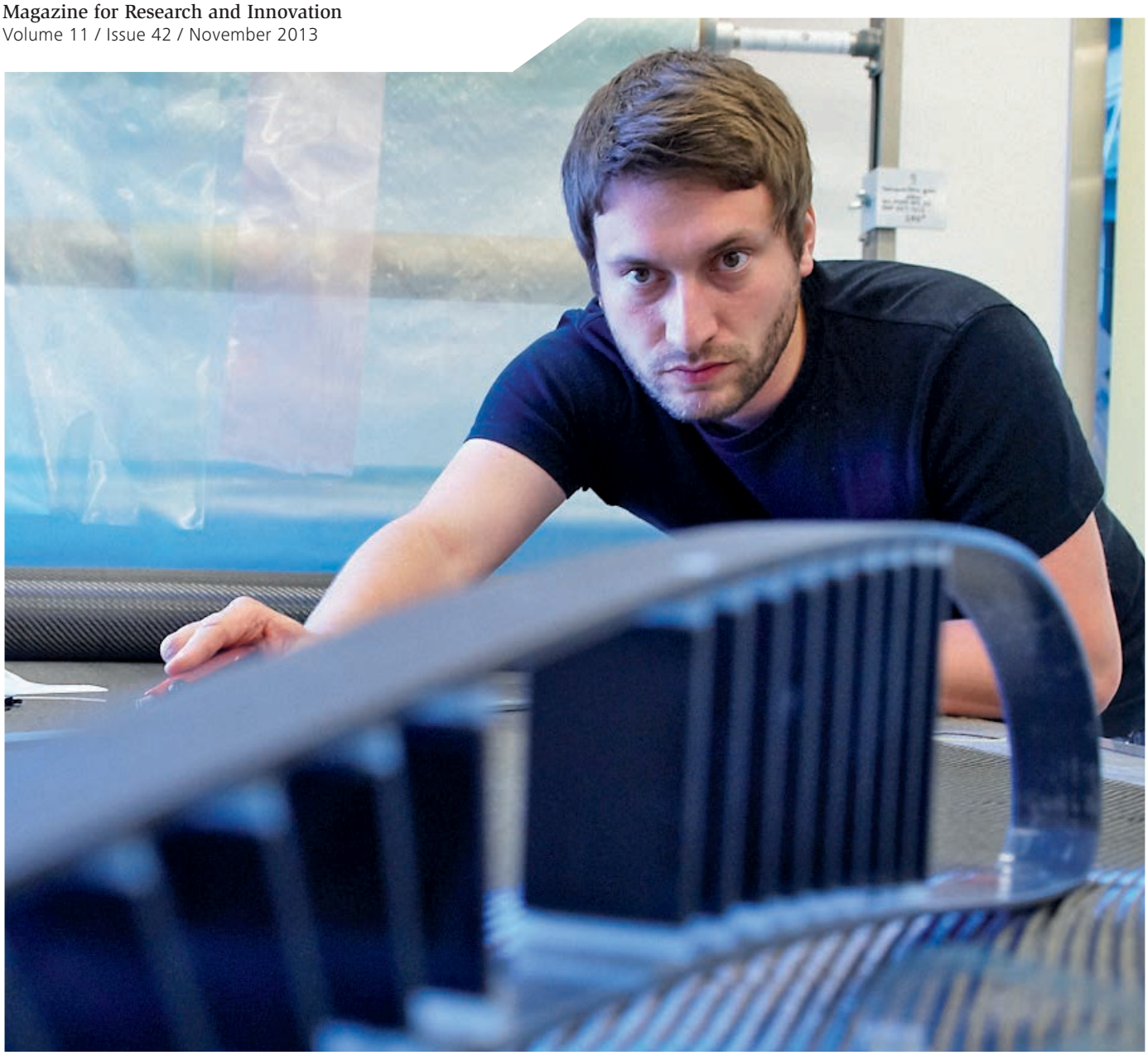
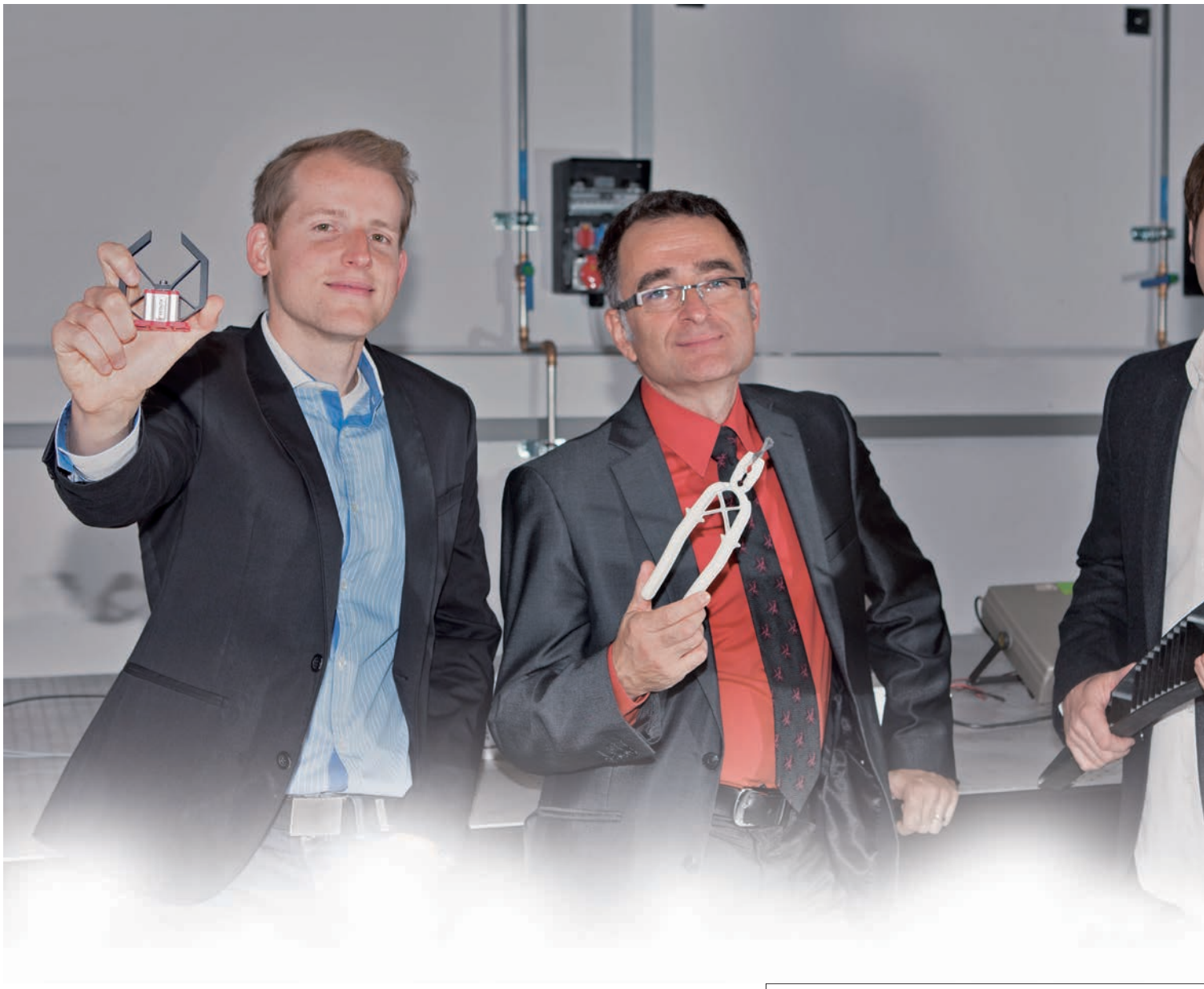


Motion without grease

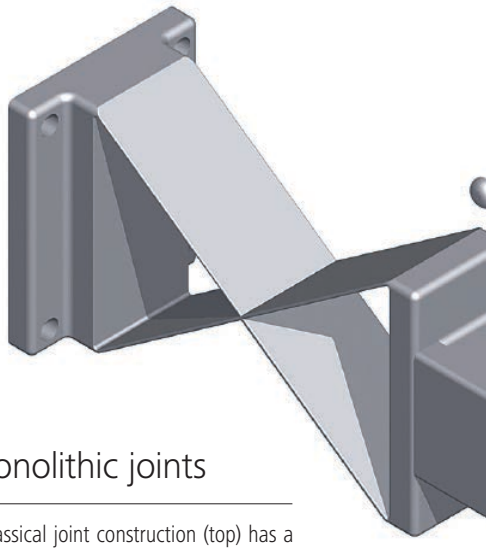
EMPA
Materials Science & Technology



The death knell for joints

Monolitix, a new Empa spin-off, specializes in flexible mechanisms, which are frictionless, wear-free, and lighter, more hygienic and affordable than conventional joint mechanisms. The potential for numerous applications is huge in a vast range of fields. The neo-entrepreneurs are now in the process of conquering the market with their first products.

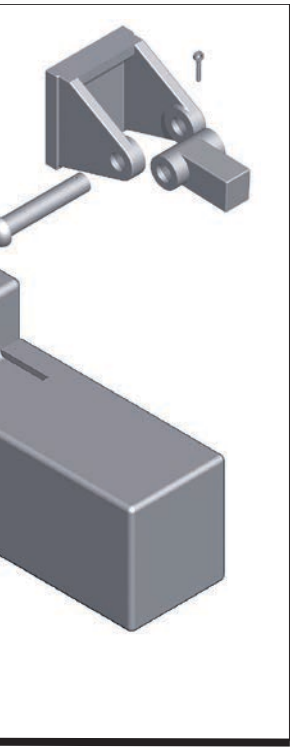
TEXT: Martina Peter / PICTURES: Empa



Monolithic joints

A classical joint construction (top) has a conceivably simple design. A monolithic solution (below) is more complex in design terms but offers numerous advantages during operation.

Empa-researcher and Monolitix head Flavio Campanile (center) and his colleagues René Jähne and Alexander Hasse: Intelligently constructed flexible components may consign joints to the history books.



We are surrounded by jointed objects from dawn till dusk. "We encounter them in thousands of different forms," explains Flavio Campanile, an aeronautical engineer and Chairman of the Board at the Empa spin-off Monolitix; as a hinge on the kitchen cupboard, from which we grab our coffee caddy in the morning to the toggle switch we use to turn off the bedside lamp before going to sleep. Without joints, everything would be rigid: our cars could not be steered, neither could the brakes on our bikes be applied. However, it took Campanile some time to realize that the optimization of these joints also harbored a lucrative business idea.

The "tweezers" principle

The ETH Zurich lecturer and head of the Empa Center of Solid-State Kinematics and Actuation has been concentrating on so-called compliant systems for over 15 years. The trick: rather than facilitating movements via classical bearings and joints, these elements are deliberately dispensed with in "solid-state mechanisms". Instead, the material is controlled and deformed reversibly. Metaphorically speaking, instead of a pair of pliers comprising several parts, which typifies the traditional joint principle, Campanile focuses on a pair of tweezers made of a single, elastically ductile component.

"The advantages of monolithic systems are plain to see," explains Campanile. Mechanisms without joints are frictionless and wear-free and thus do not require any maintenance, which can drastically reduce the running costs of machines and instruments. They are also an asset where high hygiene standards are required, such as in medical technology or the food industry, because they are easier to clean and sterilize. Moreover, the assembly costs for solid-state mechanisms can be slashed or even eliminated completely, which means considerably cheaper production processes.

And finally flexible mechanisms can also perform functions that are unthinkable with conventional systems: aircraft wings, for instance, where the shape – like their role models in nature – can constantly be altered, thus optimizing the use of aerodynamic forces. Rear spoilers for racing cars that generate greater downthrust with the same resistance and thus ensure that the vehicle travels at a higher curve velocity are also conceivable.

At first, Campanile did not recognize the economic potential of these systems, he says. Only when his PhD students looked into the topic did things start to take shape. The first prototypes for medical technology were developed during René Jähne and Alexander Hasse's dissertations at ETH Zurich. The ideas simply kept on coming thick and fast. The three-man team spent years conducting research at the Mechanics for Modeling and Simulation laboratory of Empa and developed procedures to analyze flexible elements and their deformations, and algorithms for form optimization. Their results were channeled into software modules, databases – and patents. By 2010 the time had come to found a company.

Already with products on the market from the outset

It is not every day a spin-off that already has a product on the market applies to be accepted in Empa's "business incubator", says Mario Jenni, head of glaTec, the Empa's start-up center in Dübendorf. But sure enough, Monolitix had already found its first customer for its robotic grab before the company was actually founded: bakery-product producer HUG uses it to carefully, quickly and hygienically remove small shortbread flan cases from the production line and place them in the packaging.

Like every spin-off at the Empa start-up center, the Monolitix team is also learning to deal with the highly individual challenges on the path towards independence. For Campanile and co. the key is to get new customers interested with their numerous ideas and encourage them to develop novel products together. The head of product development at Monolitix, René Jähne, explains: "As a small firm, it would be too expensive for us to develop and sell complex products for a specific market all by ourselves." Although they offer a small but high-quality series of grab systems from a catalogue, he expects far more success from actively approaching manufacturers of machine parts, tools and instruments. "This would enable us to get to know the needs of individual partners and their markets better, project by project," says Jähne. In return, the discussions offer customers an insight into Monolitix's engineering work. It soon becomes clear that ultimately designing a flexible system can only occur across disciplines and with a lot of knowhow.

There is a demand for the new technology, the founders proudly note, and point out that financially Monolitix is already standing on its own two feet, which is rather unusual for such a young company. According to its business plan, Monolitix should blossom into an SME with around 40 employees within the next five years – a perfectly realistic goal if things continue to develop at this rate. //

Video
Monolitix – a spin-off from Empa

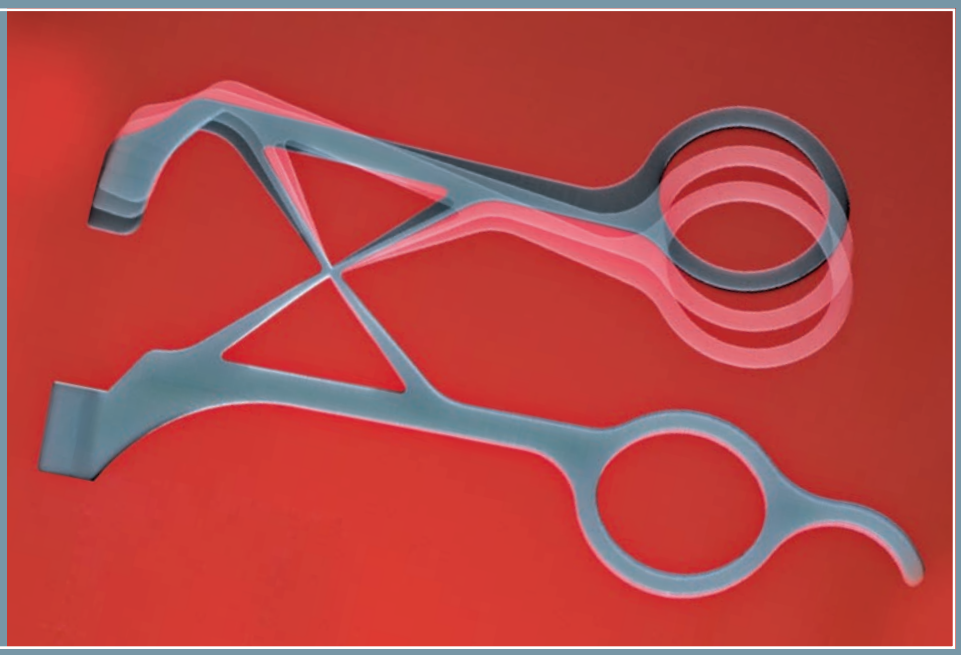
http://youtu.be/4v-GR1avR6Q

Nomination for the De Vigier development award 2013
http://youtu.be/lTZqBAGYGKM

01

MEDICAL TECHNOLOGY

Surgical instruments need to be sterile. If they only consist of one piece, bacteria can no longer get into the joints and hinges. And thanks to the drastic reduction in the amount of installation work involved, production costs can also be slashed.



02

AUTOMATION

With its batch-produced jointless grabs, Monolitix provides a maintenance-free alternative to conventional robotic grabs. They are extremely light, frictionless and play-free.

03

MECHANICAL ENGINEERING

Throughout production, processing and conveyor systems, conventional hinge connections provide the necessary movements. The jointless, mechanical systems developed by Monolitix enable major savings to be made on construction, production, assembly and operating costs.

04

CLOCK MECHANICS AND PRECISION ENGINEERING

Conventional clockworks comprise numerous lever mechanisms. By using high-precision, frictionless and maintenance-free compliant structures, Monolitix has successfully demonstrated that clockworks become more efficient while reducing the number of components.

All greased up and nowhere to go!

One-piece compliant components could soon be used in many fields. Read on to find out how and where.

PICTURES: Empa, iStockphoto.

05

SPORT

In sport, jointless, ductile mechanisms could be used in wing sails for high-tech sailboats (like the ones just used in the America's Cup), front and rear spoilers for Formula-1 racing cars, the soles of sports shoes or flexible wings for gliders.

06

POWER GENERATION

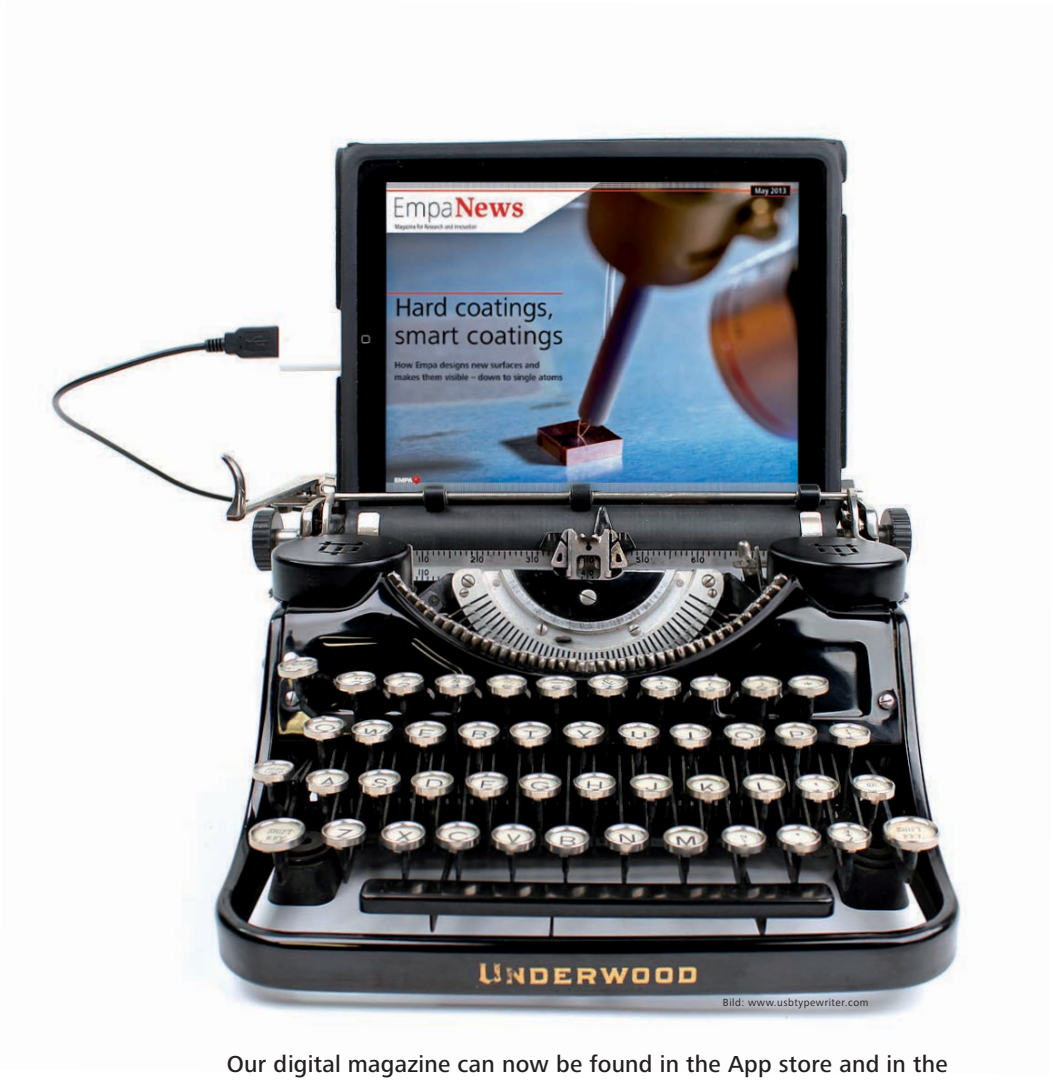
Compliant concepts are just the ticket for rotor blades on wind turbines that are difficult to access or roller and slide bearings in solar power stations that are exposed to mud, sand or dust and have to work under extreme conditions.

07

COMFORT

Car seats with compliant "rib structures" offer more comfort for the driver by taking the load off or offering support with pinpoint accuracy. The healthcare bed made of compliant elements by the Empa spin-off compliant concept to prevent bedsores offers patients continual, gentle repositioning.

Coming soon to a tablet near you!



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TOUCH THE SCIENCE