

Straighten your back, pull your shoulders down, breathe deeply. This could be the beginning of a meditation session, but it could just as well be a subtle set of signals sent by your new running kit. Clothing that provides resistance to boost training, power-assistance for muscles, designs that call for human and machine input all point to a new wave of innovation in baselayers.

Augmented baselayers

In a move to make running clothes smarter, German knitwear brand Falke has worked with the University of Ulm to develop its Impulse running range. The range features special knitted and silicon knobs that are said to activate receptors in the fasciae, the band of connective tissue beneath the skin. These will, the company claims, have a positive effect on body, posture and motion coordination. "Fasciae are primarily responsible for detecting and transmitting mechano-sensory stimuli when the body is at rest or in motion. In short, fasciae are the tissue responsible for the body's self-perception which constantly informs our brain of the body's position and movements," states Dr Heike Jäger, a member of the Fascia Research Group at Ulm University. If these receptors are stimulated, "the body will 'answer'," says Michael Klein, Falke's innovation manager, noting that this will translate into better movement coordination.

In the design process, Falke identified the

proprioceptors that it wanted to stimulate. "When we run, our shoulders often inch upwards, and this is bad for the neck. We located the muscle that pulls the shoulders down and placed knobs there to stimulate that area," says Mr Klein. All the aspects of good running form were investigated, including core stability and hip alignment, to develop the patented system. In addition, the brand has also developed socks that activate the very dense network of receptors located under the soles of our feet. The whole process took the company between two and three years, as it is a new area of research for textiles and there was little to no existing data to start from. Mr Klein notes that it also helped that Falke has its own manufacturing facility to test the various iterations.

The protruding elements in the Impulse running range may feel distracting for some, but he claims the feeling wears off after ten minutes or so, and the effect will become subconscious. "In time, the body learns to sense the best

Inspired by kinesio tapes and further recent research into the role of fasciae, the Impulse running range by German brand Falke features knitted and silicon knobs that function as 'activators' sending signals, or impulses, to the motor centre in the brain.

 Falke

position. The clothing works like a kind of subliminal coach."

Smart pants and better training

The smart yoga pants created by fashion tech company WearableX send vibrating signals to the wearer to indicate proper position in a wide array of yoga poses. Achieving the right intensity for these haptic signals was a long process, as Olivia Burca, the company's garment engineer, told WSA. To adapt to each person's individual sensitivity, the power of the haptic signal can now be adjusted on the accompanying app.

While proper position is an important aspect of optimised training, New York-based Physiclo is looking to boost the effect of running with leggings that have built-in resistance bands. The founders originally developed the concept for physiotherapy, but then shifted to the fitness market and launched via an Indiegogo campaign in 2015, raising \$153,000, enough to fund its first production run.

"There are basically only two ways to intensify a running session," says Frank Yao, Physiclo co-founder and former medical student at New York University, "either run longer or run faster." Another option is to wear tights that provide resistance to forward movement, such as those developed by Physiclo. Mr Yao says this solution is better than wearing ankle weights, which he says modify how you run. "The effect of wearing our pants is similar to running in shallow water, which requires just a little extra effort," he says.

The Physiclo range currently includes long and short running bottoms, for men and for women, with the resistive elements placed around the hips and upper legs in a multi-layered design. Different versions of these have been developed since the company launched, as it discovered new fabrics and optimised the placement and design of the elastic bands. The company has also conducted two studies to measure the effect of its clothes. In one study, wearing the bottoms was found to increase energy expenditure by 15%. Another study showed an eight-minute improvement on average in marathon and half-marathon training. Though the number of participants in both studies was low, the conclusions were encouraging.

The company is now working on developing its first top with resistive functions. It would probably not be for running, but for a sport that engages the upper body, which could be basketball, for instance.

New thinking in body-mapping

Active Spine by Swiss active underwear brand Odlo International won an Ispo Gold Award at the start of this year for a top that combines biomechanical elements with high-tech knitting in a patent-pending design that is said to "ensure



posture control during and after sports, for enhanced performance, recovery and posture correction". It is part of a revamp of the company's product range, also seen in the collaboration with the Zaha Hadid architecture studio. The architect's signature curvilinear and futuristic designs have proved to be well suited to clothing, updating classic body-mapping patterns.

Advanced body-mapping is a key specialty of Italian knitting specialist and former X-Bionic manufacturing partner Trerè Innovation. The Asola, Italy-based company has launched its own brand of high-tech underwear under the brand name Uyn and developed high-tech briefs for cyclists in its For.Bicy label. Made on seamless knitting machines, the patented design features a special pocket to place a gel cushion, which can be removed when transitioning from

Design studio Eva x Carola is investigating the customisation options inherent to seamless circular knitting. It intends to develop bodywear informed by user needs and a database of textile properties that could generate new body-mapped designs.

 Studio Eva x Carola and Santoni Shanghai



Developed by Italian knit manufacturer Trerè Innovation, this innovative boxer and pad concept is designed for bike commuters.

 For.Bicy

a cycling to a non-cycling activity.

Versatility is a big trend in first-layer performance clothing and seamless knitting is enjoying a comeback for Simon Whitmarsh-Knight, in charge of the European market for performance textiles for Korean fibre producer Hyosung. The maker of Creora elasthane yarns pairs the elastic function with other properties, such as an odour-neutralising effect, with Creora Fresh, or the possibility of achieving a deeper, darker black with Creora Black.

Seamless circular knitting is at the centre of current research projects by design studio Eva x Carola. Founded by two Dutch designers, Eva de Laat, who is based in Shanghai, and Carola Leegwater, who is based in London, the studio has a long-standing partnership with Italian company Santoni, a manufacturer of circular knitting machines.

The project the two designers are working on will create next generation seamless activewear informed by data, both textile-based and user-generated. "We start our design process from the yarn up," Eva de Laat tells WSA. "With seamless knitting, we can engineer each stage of the manufacturing process, literally stitch by stitch." The functions of breathability, ventilation, odour-control or compression can all be fine-tuned to need, says Carola Leegwater. The studio has worked with many different types of yarns and blends, including Invista, Nilit, Aquafil, Kevlar and Dyneema.

For their current project, the two designers in partnership with Santoni Shanghai are adding software and artificial intelligence into the mix to develop truly personalised clothing, with the help of two universities, Suzhou University in China and Saxion University in the Netherlands. Seamless knitting is akin to additive manufacturing (a subject covered by WSA in Jan/Feb 2015) making it possible to "programme the material," the designers note in their project description. The technology can be tailored to the needs of each individual. Once the digital interface is developed, which could take a few years, the designers say, consumers will be able to design their own products. "This will create an entirely new relationship, connecting the machine manufacturer directly with the consumer. In turn, the manufacturer will benefit from a new understanding of the needs of its market. By extension, this digital system will be self-learning; the more input it gets from the market, the more intelligence it gains," they say. This is a place to watch, as data-generated designs could be a new area of research for innovative textiles and clothing concepts.

An extra set of muscles

Even Silicon Valley has a thing for innovative textiles. A recent future-forward project was

Silicon Valley company Seismic seeks to fuse robotics and textiles. This prototype garment presented in September is designed to "look and feel like apparel but function more like an extension of the body," the company claims.

 Seismic

officially presented by Seismic, based in Menlo Park, this past September. Seismic is the new name of a company formerly known as Superflex, specialising in exoskeletons developed for the US department of defence. This summer it acquired the intellectual property of Lumo Bodytech, a start-up that had developed smart modules to monitor running and posture.

The company's latest prototype combines textiles and electronics to provide the wearer with what it is calling "an extra set of muscles". The suit is designed to provide support to the body core, with modules that deliver "up to 30 watts of power to each hip and the lower back" according to company documents. These are said to help the wearer when sitting, standing, lifting or carrying. Rich Mahoney, Seismic CEO and founder, insists that the company is in the apparel business and not a robotics company. He hopes to launch a commercial activewear product derived from this concept in 2019.

These are some of the many projects charting unknown territory in next-to-skin clothing. As each new concept emerges it brings to light the many possible developments that have yet to be explored relating to health, performance, comfort and customisation. 



Resistive running pant maker Physiclo has developed a multi-layered concept that integrates a complex array of high-stretch bands. The company is currently working on a new, lighter-weight version that should be available in early 2019.

 Physiclo

