KNITTED SATELLITES

Knitted satellite mesh antennae, socks that monitor diabetic patients and seats that tell when pilots and drivers are stressed – welcome to the materials of the future.

High-tech electronics and textiles might seem like worlds apart, but at NTU they're being brought together to create innovative products that are improving healthcare, defence, aviation and communications.

The research is the work of the Advanced Textiles Research Group, led by Professor Tilak Dias. The group's broad scope and its focus on fusing scientific, engineering and design disciplines to create electronically active smart textiles, make its research unique nationally and internationally.

A recent innovation to come out of the group are 'smart socks' that allow doctors to remotely monitor diabetic patients.

The Smart Sock System uses tiny sensors – thermistors – which are less than a millimetre long to monitor foot temperature. The thermistors are embedded into the yarns of the socks and are too small to be seen or felt by the wearer. Using Bluetooth technology, the socks send temperature data via the patient's mobile phone to the doctor's computer.

People with diabetes can have reduced nerve function, leading to severe foot ulcers and a high risk of infection, gangrene and even amputation. A temperature difference between the two feet can be one of the first signs of an ulcer forming. It's believed that temperature monitoring can reduce diabetic foot ulcers by up to 72%.

High anxiety

Similar technological applications are also being explored in the field of aviation, where Tilak and colleagues are developing materials for cockpit seats to monitor pilot anxiety levels.

Indicators of stress, including a variable heart rate, perspiration and body temperature, are captured through a range of sensors embedded into the yarns of the seat cover.

"By using smart textiles we're able to provide new prognostic and diagnostic techniques for pilot monitoring in a completely non-intrusive way," says Tilak. "This will enable the collection of data that will indicate the psychological experiences a pilot goes through while navigating a plane, potentially through unknown situations." This information can then be used to improve pilot training and reduce workload during a real flight.

Thinner than a human hair

Flying even higher, the research group is collaborating with space technology company Oxford Space Systems to knit satellite mesh antennae using gold wire that's thinner than human hair.

"Few people associate knitting with high-end space technology," says Tilak. "However, due to the advancements in knitting technology, we can now knit an antenna that's extremely lightweight, cost-effective and robust enough to withstand solar radiation."

WORKING WITH THE ADVANCED TEXTILES RESEARCH GROUP AT NTU AS A PROJECT PARTNER IS AN ABSOLUTE PLEASURE. THEY'RE A FANTASTICALLY FOCUSED AND INTELLIGENT GROUP OF PEOPLE. WE'RE ALWAYS PLEASANTLY SURPRISED WITH HOW QUICKLY THEY GET THINGS DONE

DR ASH DOVE-JAY, PROJECT MANAGER, OXFORD SPACE SYSTEMS, HARWELL SPACE CLUSTER

The knitted antenna will open like an umbrella and form a parabolic shape to reflect high-frequency radio signals.

"By making an antenna as lightweight as possible, we can save on valuable materials and make the technology easier to deliver to space," adds researcher and senior lecturer Will Hurley.

"And by applying novel knitting techniques we can eradicate waste from the manufacturing process and save on valuable resources."

Go to www.ntu.ac.uk/research to find out more about these and other inventions by the Advanced Textiles Research Group.

'Space cloth' aims higher

A PhD student who invented an incredibly flexible new non-woven material is raising funds to take her creation to the next level, realising its exciting potential as a smart textile.

When Sonia Reynolds brought her idea to our Advanced Textile Research Group, the team took her on as a PhD student to develop a novel manufacturing process.

Nicknamed 'space cloth', Zephlinear is unlike traditional woven or knitted materials. Instead, it's made from a new technique known as yard surface entanglement.

"Because of the material's linear channels of yarn, it has great potential to be used as a smart textile," Sonia explains. Professor Dias, who leads the University's Advanced Textiles Research Group, said: "Zephlinear is a remarkable development in an industry which is advancing at an incredible pace."

The material is much less labour intensive than traditional woven fabrics, and is also lighter, more flexible and more environmentally friendly to produce.

Sonia has already gained a lot of industry attention for her invention, and won the 2016 Wool Innovation Prize from The Worshipful Company of Woolmen.

She's now launched a Kickstarter campaign to raise funds for further research and to create a new textile machine that will automate Zephlinear production.

Visit **www.zephlinear.com** to find out more.