

School of Art & Design

Advanced Textiles Research





Explore the possibilities of advanced textiles

Advanced Textiles is a vibrant Research Group within Nottingham Trent University (NTU). We endeavour to improve knowledge and innovate in the science and engineering of fibre materials to produce smart and intelligent materials to be capitalised on by industry.

The demand for complex fibre materials for medical, engineering and technical applications has dramatically increased during the last few decades. Many traditional textiles companies have diversified into newly emerging markets in technical textiles. At NTU, we can provide the expertise and understanding of fibre materials and their manufacturing technologies to guide the global textile industry and collaborate on leading research.

www.ntu.ac.uk/fibrematerials

We have unique expertise in fibre processing, the characterisation of fibres and the production of fibre materials through knitting, weaving and braiding. A major focus of our work is electronic textiles. We are currently integrating electronics into the core of yarns to produce robust, fully flexible, machine-washable clothing. There is a huge range of potential applications for the core technology ranging from monitoring vital signs in the medical industry, to performance monitoring in sports, to measuring the performance of structures in architecture and textile composites in the aerospace industry. The technology will not only touch industry but all of us who use personal electronics in the form of wearable computers. communications devices and electronics. for social interactions

We are at the forefront of electronic textiles research and continually strive to shape lives and society with innovation. Read on to learn more about the work we do and how we are changing the advanced textiles industry.

Driving solutions in heated textiles

NTU researchers are applying expertise in electronic textiles and 3D knitting to work closely with industry to develop electronically-heated textiles. The technology has the potential to benefit a range of people, from outdoor sports enthusiasts to patients with Raynaud's phenomenon.

We provide a unique input into the aesthetics for commercial products together with specialist technical expertise. EXO2 Technologies Ltd called upon such capabilities to initially develop knitted heater elements for a heated glove for outdoor sports and motorcycling.

Our researchers developed a heating element that is completely textile based and produced using our progressive knitting technology. The resulting glove is flexible and comfortable, beating competing technologies that have rigid heating elements. The whole glove can also be knitted in one piece, which lowers costs and eliminates the need for uncomfortable seams, and can be washed and tumble dried. The product has achieved considerable commercial success. The team is now turning its attention to applying the technology to Raynaud's phenomenon, a condition in which a short exposure to the cold can restrict blood flow to the fingers, which can be incredibly painful. We are collaborating with Aintree University Hospital NHS Foundation Trust and EXO2 Technologies on the project, as well as the Raynaud's & Scleroderma Association. Trials of prototype gloves have been extremely positive.



Breaking the boundaries of radio communications

NTU is contributing specialist knowledge of textile materials properties, performance and design to develop a new antenna, which will be a major asset to the military as well as search and rescue teams.

The groundbreaking project, a consortium with Loughborough University and several industrial partners, aims to produce an embroidered fabric antenna and associated electronics, which could be integrated into clothing. Traditional monopole antennas are bulky, heavy and prone to breaking. They can also attract unwanted attention for the military during covert and security operations. This new design solves such problems by being small, lightweight, flexible and weather resistant.

The research team is initially focusing on radio communication applications and is striving to produce an antenna that is capable of operating at megahertz frequencies, yet is cost-effective to manufacture.

The project is funded by a grant from the Innovative Electronics Manufacturing Research Centre (IeMRC). Production of the first prototype garment is almost complete, which will soon proceed to rigorous testing.



The next generation...

NTU aims to transform the way electronic textiles are produced by fully integrating electronics into the core of yarns. This revolutionary concept will incorporate information technology into textiles using conventional textile processes to produce the next generation of electronic textiles.

Our researchers are currently developing a robust, low-cost, platform technology to produce electronic textiles for military applications. Supported by the Ministry of Defence, we are exploring the concept of protecting electronics within micro-pods and placing these at intervals along the length of yarns. The fibres of the yarn are not constrained between micro-pods so this helps retain the characteristics of the fabric. The yarn can also be processed by knitting, weaving, and sewing using conventional textile machinery, which will ensure costs are feasible.

Integrating electronics into clothing has a number of benefits and numerous potential applications for the military, such as devices for communications, vital sign monitoring, such as ECG measurements, and the detection of harmful gases or radiation. There are also possibilities outside of the forces, such as for medical, sports and public applications or for automotive, architectural and aerospace applications where there are advantages to monitoring structures internally for performance. Our ultimate goal is to develop yarns with a multitude of fully integrated electronic components that can be knitted or woven into a fabric or sewn into a garment. A series of addressable components could be connected in series with a signal bus in order to distribute components throughout a garment, which would represent a truly flexible, drapable and washable textile computer.

Our proposed work will take electronic textiles well beyond what is currently available in the market to produce a solution that will be a true merger between the textile and electronics industries.

Find out more

Our blog reports our latest progress as we develop electronic textiles and other advanced textile technologies:

www.ntuadvancedtextiles.wordpress.com









Superb facilities

Our students and research staff benefit from the excellent facilities that make NTU one of the best learning environments in the UK.

The Advanced Textiles Research Group is housed in the School of Art & Design. The School brings together research relating to the entire range of fibres and materials, from the development of electro-active fabrics to work relating to the history of Nottingham's textile heritage. Our multidisciplinary group encompasses knowledge from the disciplines of mathematics, physics, electronics, electrical engineering, mechanical engineering, materials science, textile engineering, textile design, and product development.

This cross-disciplinary capability means we can research problems and understand complex phenomena that are fundamental to textiles and their applications in fashion, art, craft, medicine and smart materials. Modern textile production and testing technology is supported by leading science and we have insights into material performances that derive from design and craft skill. Key research facilities of the Advanced Textiles Research Group include an electronic textiles fabrication laboratory and an electronic textile testing laboratory. We also have access to the latest textile manufacturing technology, including digital manufacturing technologies for computerised flat-bed knitting, Jacquard weaving, laser cutting, embroidery and ink jet printing as well as textile design studios.

Our leading-edge technology in combination with our cross-disciplinary expertise allows us to bridge the gap between different areas of textile research to create complete solutions.

To learn more about the facilities at NTU, visit **www.ntu.ac.uk/createresources**

Work with the best

Our academics work at the forefront of their discipline and have the specialist knowledge and expertise that is demanded in modern textiles research. We are proud to have the only Professor of Knitting, Professor Tilak Dias at NTU, who directs the activities of the Advanced Textiles Research Group.

Professor Dias brings a unique background in electronics, textiles and electronic textiles to the School of Art & Design. He is leading the development of research in the fields of knitwear, technical textiles and smart textiles, to enhance NTU's capacity to undertake internationally excellent research.

Developments to date include wearable technologies for medical applications that include a vest for vital signs monitoring and gloves and socks for use in stroke rehabilitation. Professor Dias is also developing wearable electronic systems for the military and smart textiles for the automotive industry.

Professor Dias is motivated in his work by the possibilities of creating knowledge. "I like to push the boundaries of existing technologies," he comments. "I'm aware of the limitations and what can be surpassed." Professor Dias has developed three novel core technology platforms, which have resulted in the formation of three spin out companies in the UK for their commercial exploitation. He has also published over 100 scientific papers in leading journals and conferences and is named as the lead inventor in 40 patents.

Of all his achievements however, Professor Dias is most proud of becoming the first Professor of Knitting and is excited about what NTU can achieve in the coming years.

"The textile industry is an exciting evolving industry. Textile technology is over 30,000 years old and what has been achieved in that time is considerable, from once leading the industrial revolution to the stage where we have fully computerised, optimised, tested machines with very high production rates. There is now increasing interest to develop new materials using this platform, which will lead to ever greater possibilities."



To find out more about Professor Dias, visit the School of Art & Design website: www.ntu.ac.uk/art

Sharing knowledge to excel

Collaboration is important to the Advanced Textiles Research Group and we welcome input from companies, educational institutions or individuals who are keen to work with us to advance new ideas and technology.

Our core activity is research. We believe in sharing ideas and collaborating to take our pioneering research forward from the laboratory to industry.

We have collaborated with a number of educational institutions to date, including Loughborough University (Wireless Communications Group), the University of Sheffield (Department of Electronic and Electrical Engineering), the University of Salford (Centre for Rehabilitation and Human Performance Research), and the University of Bath (Department of Electronic & Electrical Engineering), sharing expertise on research projects and working together to find solutions. We have also established excellent relationships with commercial companies including Stoll GmbH, Intel Corporation (Intel Labs) and Luxilon Industries NV. We offer a range of services for businesses of all sizes and types and have the equipment and expertise to meet the demands of the global textile industry. Our researchers have an understanding of commercial structures and processes as well as fluency in the cultural drivers that influence markets and motivate consumers.



Core services we offer include:

- fundamental research on the next generation of SMART and Intelligent fibre materials;
- fundamental and applied research on novel manufacturing technologies;
- innovative product development for the industry;
- rapid prototyping –minimising lead times;
- translation of technology for product manufacture;
- mathematical modelling of textile structures ; and
- knowledge transfer.

Core technology platforms can be easily adapted to meet individual needs. From leading-edge research and consultancy to first-rate testing facilities, let us be the perfect partner to your business.



Contact us

For information about the Advanced Textiles Research Group, or about research or collaboration opportunities, contact Professor Tilak Dias:

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