“Pinch, perch, crawl and swim: Soft robots for fun and not only…”

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At first glance, one might assume that manufacturing research shares limited overlap with the field of robotics. However, such a perspective tends to underestimate the significance of engineering curiosity and imagination in bridging these domains. Our transition into robotics has been largely driven by an inherent curiosity and a commitment to solving real-world challenges—particularly those related to the inspection and remanufacturing of large, complex systems where conventional robotic solutions prove impractical or unfeasible. Rooted in fundamental physical principles—specifically, the behaviour of flexible capacitors—soft dielectric elastomer actuators (DEAs) have been developed in a variety of geometries and functionalities. These actuators serve as the foundation for a new class of soft robots exhibiting diverse capabilities, including:

- *Pinching – gentle manipulation of highly delicate objects;*
- *Perching – passive flying and crawling on surfaces at distances/hights;*
- *Crawling – sub-millimeter locomotion suitable for navigating in confined and narrow environments;*
- *Swimming – streamlined, undulating propulsion in both conductive and dielectric fluids.*

While these various DEAs have been developed/invented, initially, for fun, we took these to (near) real applications, e.g. manipulation of un-sintered components, survey of civil engineering structures, inspection of next-generation electrical machines.

Looking ahead, rather than succumbing to stagnation, we are adapting these concepts toward more robust actuation technologies that can operate in extreme conditions—such as those encountered in nuclear facilities, the oil and gas industry, and post-disaster environments. This presentation does not aim to prescribe a specific research agenda, but rather to provoke curiosity and encourage exploration beyond conventional disciplinary boundaries.

Biographies

Dragos Axinte is Professor of Manufacturing Engineering at University of Nottingham, UK. Graduated at University of Galati, Romania, after working in industrial research for nearly eight years, he held two personal NATO Research Fellowships in Italy and Denmark and then moved to UK to carry out research with University of Birmingham and later with University of Nottingham. He was appointed Lecturer in Manufacturing Engineering (2005) and successively promoted to Associate Professor (2007), Reader (2010) and Professor (2011). Since 2009 Dragos is Director of The Rolls-Royce UTC in Manufacturing and On-Wing Technology at University of Nottingham. He is Editor-in-Chief of the International Journal of Machine Tools and Manufacture as well as of the Journal of Materials Processing Technology and Fellow of International Academy of Production Engineering (FCIRP). Dragos has over 200 journal papers and over 30 granted international patents filed mainly with Rolls-Royce.

Dragos research interest is in the following main areas: Advanced machining technologies with emphasis on in-depth analysis of workpiece surface integrity; innovative tooling and fixturing systems; and development of portable machine tools and specialist robotics for in-situ repair and maintenance of high-value industrial assets.

Xin Dong is an Associate Professor of Engineering Design for Manufacturing at the University of Nottingham. Dr Dong's research interest includes the design, modelling, and control of continuum and soft robotics. He also has design and modelling experience in parallel kinematics mechanisms, miniaturised walking robots, novel actuators, and computer vision. In the last five years, he has led and participated in several projects funded by Innovate UK and the EPSRC as principal investigator and co-investigator. In the last five years, he has published 50 papers in top academic journals on robotic design and modelling, such as Nature Communications, IEEE/ASME Transactions on Mechatronics, IEEE Robotics & Automation Magazine, IEEE Transactions on Industrial Electronics. He is also an Associate Editor of the Journal of Field Robotics and the Executive Board Member of the International Federation for the Promotion of the UK.