Title: Specialist Robotics for Industrial Surgery: Repair and maintenance of high-value assets

Abstract: It is not an easy task to navigate in cramped/hazardous environments and then manipulate end-effectors to enable invasive operations. Surgeons have done so by hand for decades. But, can we do the same within industrial workspaces?

Despite of its strategic importance, the area of robotics for in-situ repair of large/intricate/complex geometry industrial equipment has been, somehow, not obtained full attention from researchers. However, due to the special operating and workspace conditions, off-the-shelf robots miss the dexterity and/or the necessary flexibility to perform such in-situ maintenance and repair tasks.

This presentation details on the exciting journey in developing of two (complementary) classes of specialist robots for in-situ interventions on high-value industrial assets: walking machine tools and ultra-slender snake-like manipulators.

Firstly, walking hexapod machine tools that could work both independently or coupled with other robotic systems to perform complex tasks in-situ industrial environments where human access and/or conventional robots cannot reach easily will be presented. Our robotised machine tool systems are capable to walk within hazardous and perform processing tasks (e.g. machining, inspection). Examples of the demonstrations of our robotic system will be presented in relation to targeted industrial applications related to high-value industrial (e.g. aerospace, nuclear) systems.

Secondly, the exciting journey on the development of ultra-slender snake-like robots will be summarised. Due to their high level of engineering maturity, they have been first demonstrated for aeroengine in-situ repair, then picked-up by other industrial operators (e.g. nuclear, telecom, oil & gas) to find additional applications into the initially unexpected field of medical surgery. This culminates with an example of an ultra-slender snake robot (5m length, 9mm diameter) that - operated either locally or remotely using a joystick - can perform both industrial and medical surgery without significant alteration to the system. Similar to medical surgery, the industrial engineers have used our snake robots to perform in-situ interventions of high-value assets (e.g., NDT, grinding/laser machining, coating repair), in other words 'industrial surgery'.

As such, these approaches contribute to the foundation of the concept of "portable factories" that can be deployed to/into industrial installations and perform maintenance and repair tasks that otherwise would be difficult and/or hazardous to be performed.

Biography

Dragos Axinte is Professor and Chair 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 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.