

# Rolls-Royce Poised to Revolutionize Engine Maintenance

**ROLLS-ROYCE** has an exciting vision of how robotics could be used to revolutionise the future of engine maintenance. Bringing another element of its “IntelligentEngine” vision to life, Rolls-Royce teamed up with academics from the University of Nottingham and Harvard University to discuss and demonstrate a wide range of potential future technologies at the 2018 Farnborough Airshow, from “snake” robots that work their way through the engine like an endoscope, to miniature, collaborative “swarm” robots that crawl through the insides of an engine.

The IntelligentEngine vision was first introduced by Rolls-Royce at the Singapore Airshow earlier in 2018. It describes a world where product and service have become so closely connected that they are inseparable. This vision drives activity across a range of fields, including robotics, with a particular focus on digital technologies.

The robotic technologies are an opportunity to improve the way engine maintenance is delivered, for example, by speeding up inspection processes or by removing the need to take an engine off an aircraft in order to perform maintenance work. This has the potential to offer significant benefits for customers by reducing the cost of engine maintenance, increasing the availability of an engine and ensuring any maintenance required is completed as quickly as possible.

The technologies on display were at varying levels of maturity and included:

**SWARM robots** – a set of collaborative, miniature robots, each around 10 mm in diameter which would be deposited in the centre of an engine via a “snake” robot and would then perform a visual inspection of hard-to-reach areas by crawling through the engine. These robots would carry small cameras that provide a live video feed back to the operator, allowing them to complete a rapid visual inspection of the engine without having to remove it from the aircraft.

**INSPECT robots** – a network of “periscopes” permanently embedded within the engine, enabling it to inspect itself using the periscope cameras to spot and report maintenance



*An artist's impression of the Rolls-Royce SWARM robot. The robot will crawl through engines, photographing hard-to-reach areas.*

requirements. The pencil-sized robots are thermally protected from the extreme heat generated within an engine and the visual data they create would be used alongside the millions of data points already generated by today's engines as part of their Engine Health Monitoring systems.

**Remote boreblending robots** – teams from Rolls-Royce and the University of Nottingham have worked together to develop a robotic boreblending machine that can be remotely controlled by specialist engineers. In practice this means that complicated maintenance tasks, such as repairing

damaged compressor blades using lasers to grind parts, could be completed by non-expert “local” teams who would simply install the tool in the engine and then hand control of it over to a dedicated expert back in Rolls-Royce's Aircraft Availability Centre who would then direct its work remotely. This removes the need for specialist teams to travel to the location of an aircraft needing maintenance, vastly reducing the time required to return it to service.

**FLARE** – a pair of “snake” robots which are flexible enough to travel through an engine, like an endoscope, before collaborating to carrying out patch repairs to damaged thermal barrier coatings.

Speaking at the Farnborough Airshow, Dr. James Kell, a Rolls-Royce On-Wing Technology Specialist, said: “While some of these technologies, such as the SWARM robots, are still a long way from becoming an everyday reality, others, such as the remote boreblending robot, are already being tested and will begin to be introduced over the next few years. We have a great network of partners who support our work in this field and it is clear that this is an area with the potential to revolutionise how we think about engine maintenance.”

Rolls-Royce works on robotics projects like these in partnership with a wide range of research organisations around the world, including the Harvard University and the University of Nottingham, which is a Rolls-Royce University Technology Centre (UTC). ●

*Image and content: Rolls-Royce*