



Intelligent Borescope for smarter engine inspections

Waygate Technologies and Rolls-Royce are working together to transform the engine inspection process.

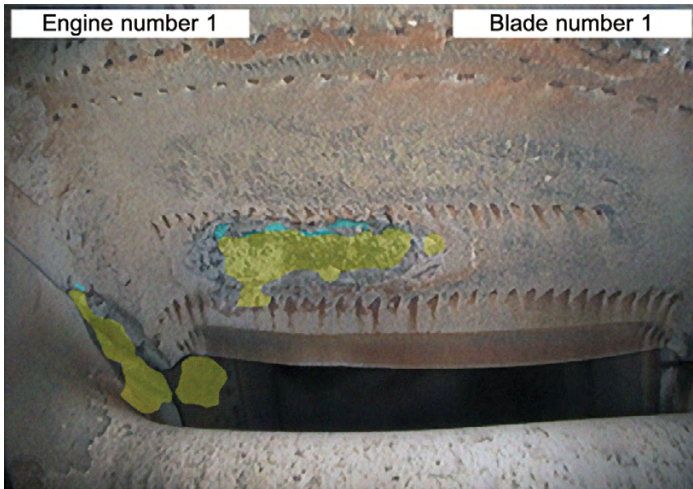
The Intelligent Borescope Method provides consistent data collection by integrating high quality equipment, overlays that standardize images, and automated reporting and data transmission to develop apps that assist the sentencing of observations and the fleet planning.

Benefits:

- Standardized inspection method
- Avoid re-inspection
- Automated report generation and sharing
- Optimize fleet planning
- Maximizes engines on wing

Challenge

High-Pressure Turbine (HPT) blades endure extreme conditions, including temperatures over 1,600°C, centrifugal forces exceeding 10 tons, and significant pressure as they harness energy from the high-speed gases exiting the combustion chamber. These factors make HPT blades some of the most vital and intricate components of an engine, directly affecting its performance, efficiency, and durability.



Traditionally, inspecting these blades to ensure they remain within operational limits has been variable. This process often produces inconsistent data, necessitating repeat inspections, leading to overly cautious decisions that may result in unnecessary engine maintenance, and causing uncertainty in fleet planning for airlines.

To help operators make more informed decisions, Rolls-Royce wanted a way to start collecting standard data with a view to leveraging AI in the future to analyze inspection datasets. The creation of an intelligent engine inspection method would increase data quality and help minimize the risk of human error and increase efficiency throughout the process.



Solution

The Intelligent Borescope Method is the result of a collaboration with Waygate Technologies and Rhinestahl, with the Mentor Visual IQ+ providing high-resolution, templated imaging systems that capture detailed visuals of the HPT blades during inspections. AI-powered algorithms subsequently analyze those images with exceptional precision, identifying even the smallest amount of wear and tear quickly, consistently and accurately.

Menu Directed Inspection (MDI) technology guides the inspector through the process and ensures captured data to include information that enables it to be processed and reviewed in an efficient and user-friendly format. Semi-transparent image overlay templates ensure the operator captures the correct views to ensure optimal and consistent data collection.

The borescope tip is enabled with a scanner that generates 3D color images. As it moves through the engine, the borescope captured images are analyzed by an app installed on the borescope handset. The app maps the blade the same way a face is mapped, looking for irregularities or inconsistencies. Never before has facial recognition AI been used in this way in aerospace inspections.

With the MVIQ+ connected to InspectionWorks, Waygate Technologies NDT software platform, the data is immediately accessible in the cloud to enable accurate maintenance decisions and optimize the time on wing of engines.

"Rolls-Royce is committed to pioneer the use of new technologies for the benefit of Service Operation for our Customers. Standardisation and quality of inspection images, starting with High Pressure Turbine Blades, deliver immediate operational benefits in sentencing efficiency and reducing human factor risk. Processing data shared in a Cloud system will then allow app development and set the foundation for future improvements."

Tony Bell
Director of Commercial Aviation
Aftermarket Engineering

Results

With this high level of innovation and partnership, Rolls-Royce can boost standard data collection, optimize its inspections, and set itself up for a future of speed, innovation, safety, and success.

With a wealth of data, Rolls-Royce are now building an enormous 'maintenance brain', containing historical inspection data, comparative analysis, and diagnostic benchmarks.

The complex design and challenging operational conditions of HPT blades highlight the necessity for advanced maintenance solutions. The Intelligent Borescope Method not only streamlines the inspection of these intricate components but also, with time on wing being a critical measure of engine performance, it can identify wear patterns early, minimize re-inspections, and enhance the reliability of maintenance planning and fleet management.

Artificial Intelligent analytics

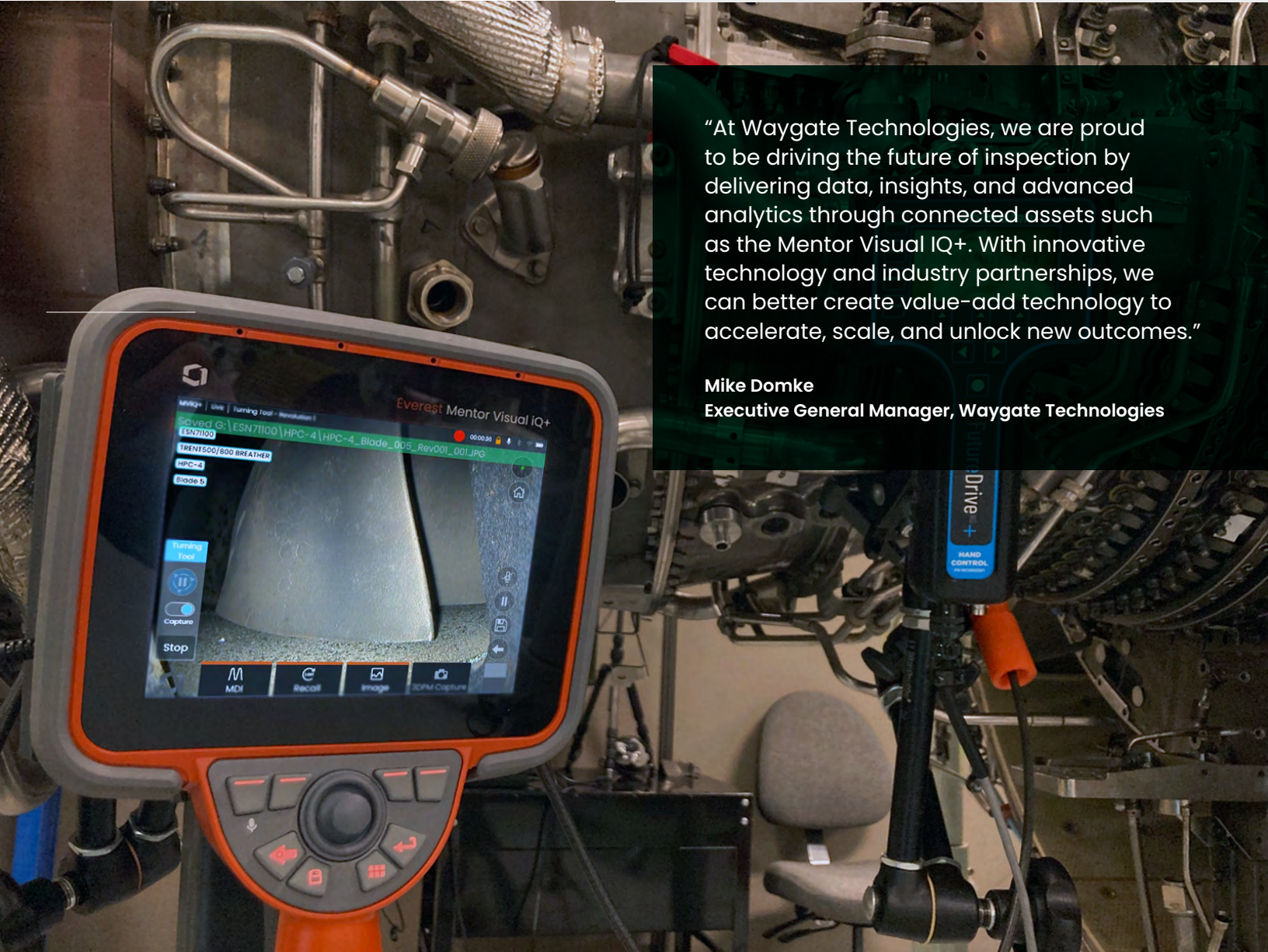
Artificial intelligence (AI) and computer vision have been combined to create bespoke apps designed to significantly improve the quality and consistency of certain in-situ visual inspections.

These apps are designed to be fully integrated into the Waygate Technologies' Everest Mentor Visual IQ+ system.

No additional laptop or companion device is needed – all the necessary computational power is fully provided by the onboard processor within the handset.

Rhinestahl's FutureDriveNG+ electronic turning tool

The Intelligent Borescope is digitally connected to the electronic Rhinestahl FutureDriveNG+ turning tool. This positions the blade to enable reliable and repeatable capture of each and every aerofoil in the stage. After each blade is successfully positioned, the tool sends a signal to the borescope to capture the image automatically. For more information, visit <https://www.rhinestahl.com/>



"At Waygate Technologies, we are proud to be driving the future of inspection by delivering data, insights, and advanced analytics through connected assets such as the Mentor Visual IQ+. With innovative technology and industry partnerships, we can better create value-add technology to accelerate, scale, and unlock new outcomes."

Mike Domke
Executive General Manager, Waygate Technologies

Specifications

VideoProbe handset kit

Part number	RR-MVIQHANDSET-KIT
Included standard accessories	Work Station Shipping/Storage Case with Integrated insertion tube storage reel, battery charger and power word, optical tip case, 16 GB USB thumb drive, user manual, accessory pouch, 1 battery, Magic Arm, 3D measurement block and DHMI-DP cable (5m)
Shipping box dimensions	57.2 x 56.3 x 41.2 cm (22.52 x 22.16 x 16.22")
System weight in case	43.2 lbs
User interface	Menu-driven and soft button operation; menu navigation using either touchscreen or joystick
Ergonomic design	Unitized hand-held design with interchangeable QuickChange probes
Illumination	White LED
Measurement	Real3D stereo and phased measurement with point cloud visualization, Projected Plane and Area Depth Profile measurement types
Articulation	360° All-Way® tip articulation, menu access, and navigation
Internal memory	32 GB
Zoom	5X continuous digital zoom
Battery	2-hr Li ion battery pack, charge while attached or detached from handset
Display	6.5" XGA LCD, daylight readable with touchscreen
I/o ports	(2) USB 3.0 "A" port, (1) USB 3.0 client micro 'B' port
Video output	DisplayPort digital video output
Still image formats	Bitmap (.BMP) and JPEG (JPG)
Video format	MPEG4 AVC/H.264 (.MP4 file)
IP rating	IP65 (assembled), IP55 (disassembled)
Military standard compliance	MIL-STD-810G 501.5, 502.5, 506.5, 507.5, 509.5, 510.5, 511.5, 514.6, 516.6, 521.3 MIL-STD-461G electromagnetic compatibility with RE102, and RS103 – above deck
Agency compliance	Group 1 Class A; EN61326-1, IEC CB Scheme, UL/EN/CSA-C22.2 61010-1, IEC 62133, UN/DOT T1-T8, EU RoHS 2, EU RED Directive, ISTA 2G

Probe & optical tip kits

Diameter	Part number	Description
6.1mm	RR-HD6130PROBE-KIT	Interchangeable probe with rigidizer, grippers and 6 OTAs: side, forward view and 3DPH measurement
4.0mm	RR-SD4030PROBE-KIT	Interchangeable probe with guide tube, probe holder and 4 OTAs: side, forward view and stereo measurement

Rolls-Royce Analytics

Part number	Description
MVIQ-ADRRRBEMAT	Blade elongation analytic
MVIQ-ADRRRERO	Blade erosion analytic