STUDENT BRIEF

EVALUATE TECHNOLOGIES TO ENHANCE NON-DESTRUCTIVE TESTING EFFICIENCY

Rolls-Royce

Summary

Rolls-Royce designs, builds and services power systems, best known for our aero engines on large passenger jets. I work in non-destructive testing (NDT), which is how we check parts for tiny flaws without cutting them open. I'd like your help to assess how machine learning and robotics could make our inspections faster and more precise, especially on composite materials used to save weight and fuel. You'll produce a clear plan with examples, risks, and a proposed pilot that someone like me could actually act on.

KEY WORDS

aerospace engines, non-destructive testing, ultrasound, phased array, radiography, computed tomography, thermography, eddy current, composites, carbon fibre, probability of detection, machine learning, computer vision, anomaly detection, robotics, automation, inspection standards, EASA, FAA, EN 4179, NAS 410, Nadcap, ASTM, ISO, benchmarking, roadmap, risk assessment

INDUSTRY

Aerospace, Engineering, Manufacturing, Energy

FOCUS

- Machine learning for ultrasonic and X-ray defect detection
- Robots and automated scanners for consistent inspections
- Testing carbon fibre composites and advanced alloys
- Certification and standards for new inspection methods
- Cost, risk and a 12–18 month pilot roadmap

Brief

I'm an NDT engineer at Rolls-Royce working on aero engine components. With air travel set to grow, we need to inspect more parts, made from tougher materials, to tighter tolerances. Composites help cut weight and fuel burn, but they're tricky to

inspect because defects can be very small (voids, delaminations, kissing bonds) and not always obvious in a scan. We already use tools like phased array ultrasonics, Xray/CT, eddy current and thermography. The question on my desk is where machine learning and robotics can genuinely help: less rework, better detection of micro-defects, and more consistent results shift after shift, all while meeting EASA/FAA rules and Nadcap audits.

Here's what I need from you:

1) Map today's toolbox

- Summarise the main NDT methods used on composites and hightemperature alloys in aerospace (ultrasound incl. phased array, radiography/CT, thermography, shearography, eddy current, penetrant). For each, note what defects it finds well, known limits for composites, typical scan times, and any publicly available probability of detection (POD) data or case studies. Cite sources (e.g. ASTM/ISO standards, academic papers, OEM or MRO case studies).

2) What's working out there

- Find 4–6 public examples where machine learning or robotics improved NDT in aerospace or similar highstakes sectors (nuclear, oil & gas, rail). Cover the sensor type, model approach (e.g. CNN for CT images, anomaly detection on UT signals), hardware (gantry, crawler, arm), reported gains (e.g. shorter inspection time, better POD, fewer false calls) and limits. Include links.

3) Two use cases for Rolls-Royce

- Propose two highvalue pilots. For each: part or area (e.g. composite fan system, additive metallic vane), target defects and minimum detectable size, sensor setup, where ML sits in the workflow, how the robot moves and controls contact, and how a human inspector signs off. List the data needed to train/validate and how you'd create or source reference standards.

4) Risks, rules and how to de-risk

- Set out the risks: false negatives, model drift, overfitting, calibration, cybersecurity of robots, change control. Then the guardrails: EN 4179/NAS 410 competence, Nadcap expectations, ASTM/ISO method standards, software version control, audit trails, regular revalidation, and human-in-the-loop review. Tie this to EASA/FAA production/maintenance approval context with references.

5) 12–18 month plan

- A phased roadmap with rough costs by category (equipment, integration, training, validation time), success measures (POD targets, false call rate, inspection time per part), and a go/no-go gate. Flag assumptions and open questions.

A strong piece will be specific, well sourced (2–3+ credible references), and realistic about tradeoffs between speed, sensitivity and compliance. Thanks — NDT engineer at Rolls-Royce.