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NATIONAL COMPOSITES CENTRE

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Transforming Composite Manufacturing: AI-Driven Defect Detection and Prediction in Real Time

Why Defect-Free Manufacturing Matters?

Critical for safety and performance

- Composite defects can lead to structural failures.
- Quality issues lead to expensive recalls and rework.

Cost of defects

- Downtime for inspection and repair
- Wastage of material

High precision demands

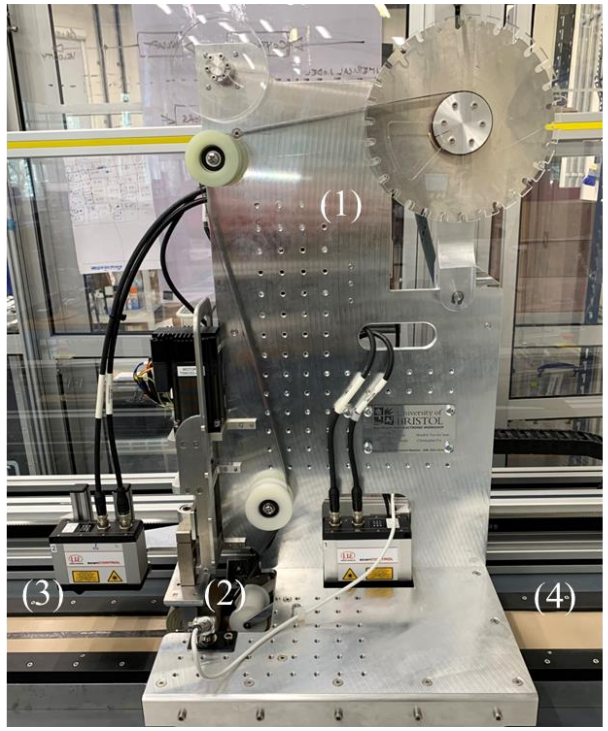
- Complex and fast-paced manufacturing processes (e.g., AFP).
- Manual inspection is slow, expensive, and prone to errors

The MTorres automated fibre placement head at Airbus applying composite tape to an A350 wing cover tool

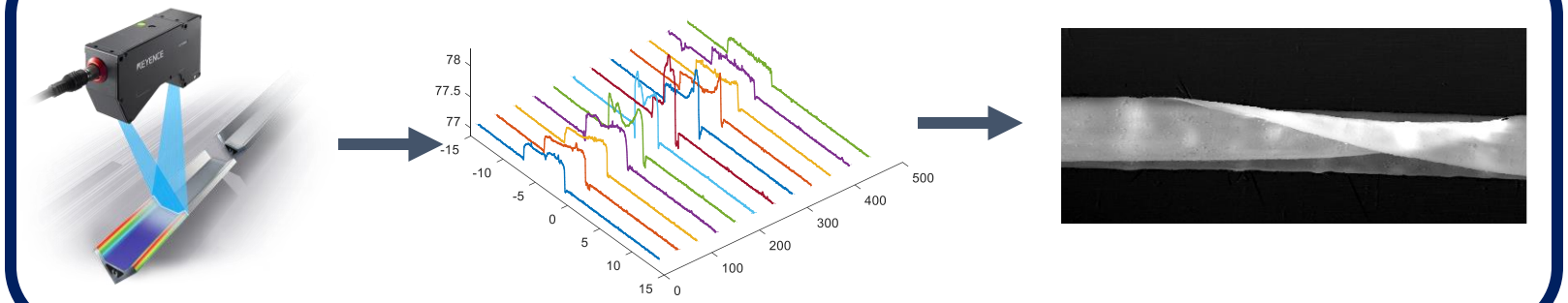
Need for real-time defect detection to minimise waste!

AI Defect Detection and Classification System

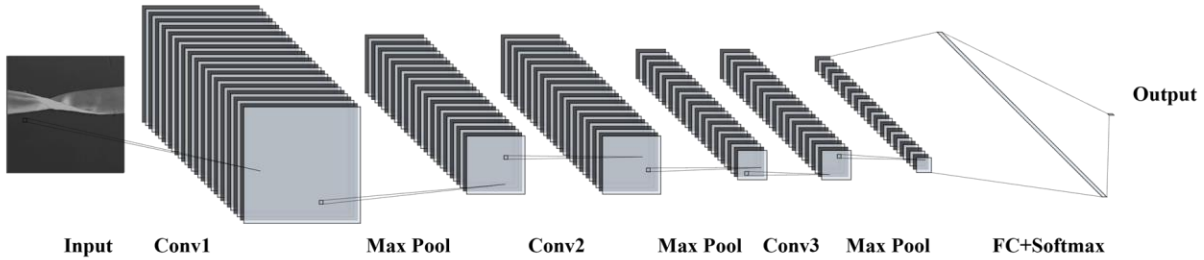
Lab Scale AFP machine



Data acquisition: 3 types of defects, dataset of 60 images of each defect



Convolutional Neural Networks



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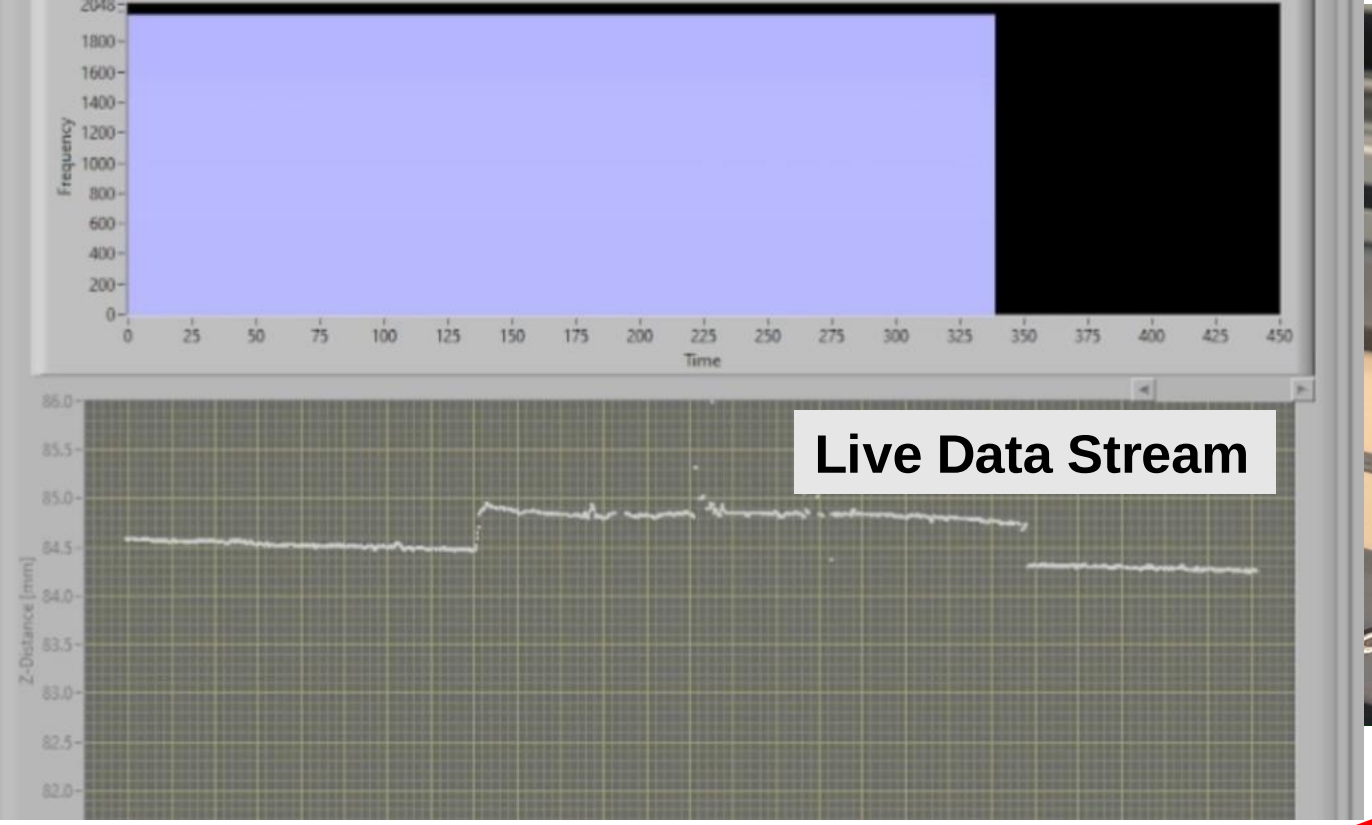
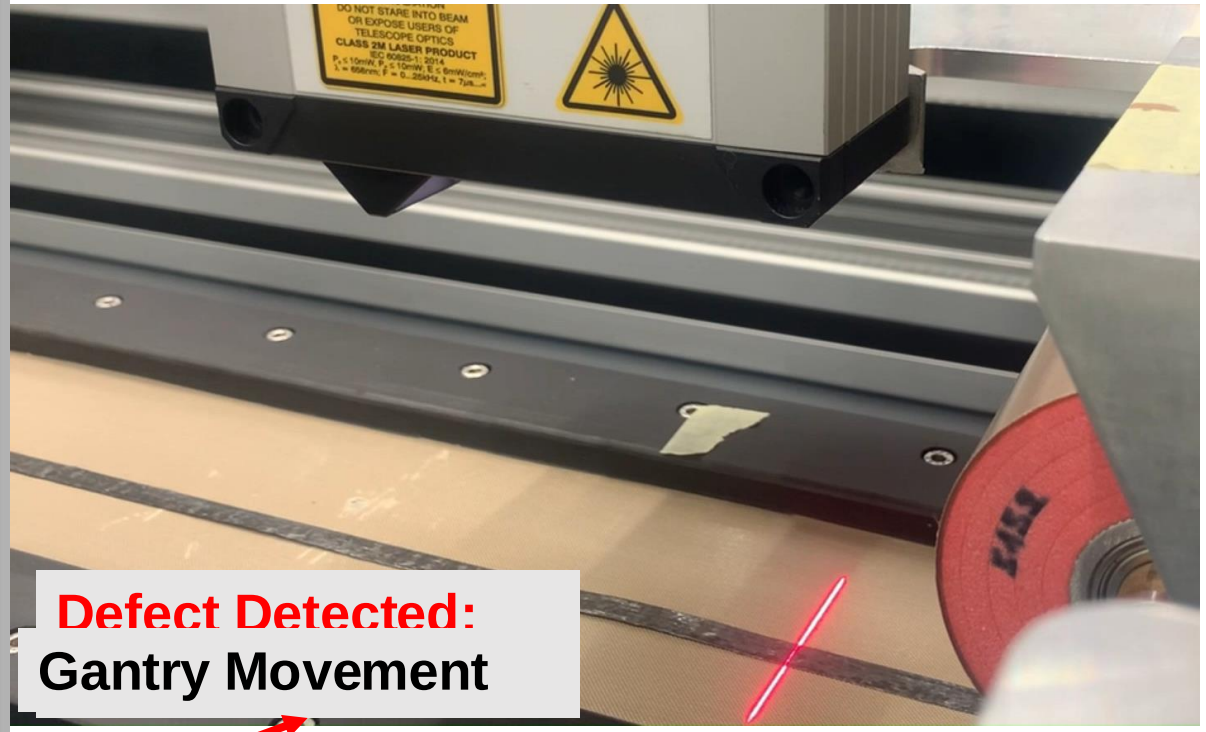


Live Data Stream



Defect Detected:
Gantry Movement

Command Line

Classification predictions: <0.5s

Sample Data: Defect Boolean & Classification Scores

In-line Defect Detection and Classification system

CNNs can be used for real time quality control

- Demonstrated on defect classification during lab-scale AFP
- Speed limitation does not come from CNN computations
- At the moment machine stops when defect is detected, but possibility to add mitigation strategies
- Robustness is under investigation

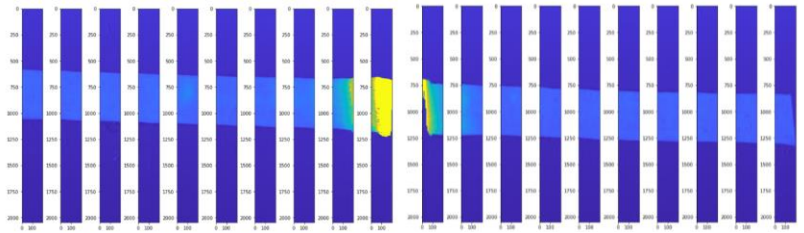
However, defects are detected after tape passed the laser sensor.

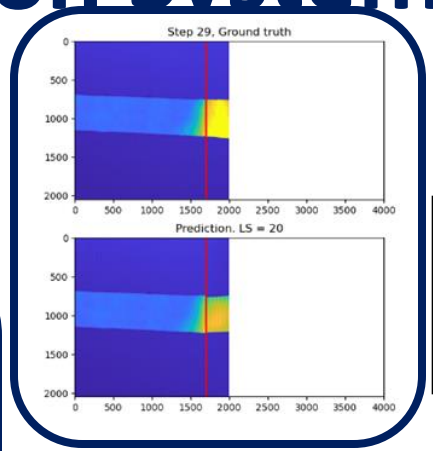
Can we predict defects before they could be seen by laser profilometry?

AI Defect Prediction System

Laser sensor image

Split into frames of 50 pixels





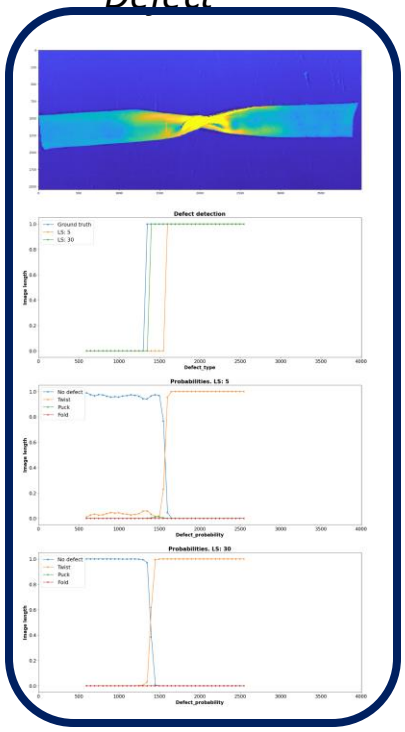
Encoder

Deep LSTM

Future Feature Vector

Classifier

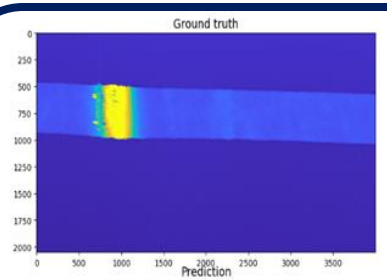
Future Defect



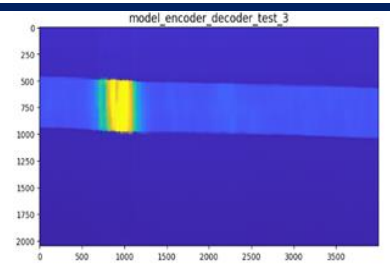
Decoder

Feature Vector

For training Only



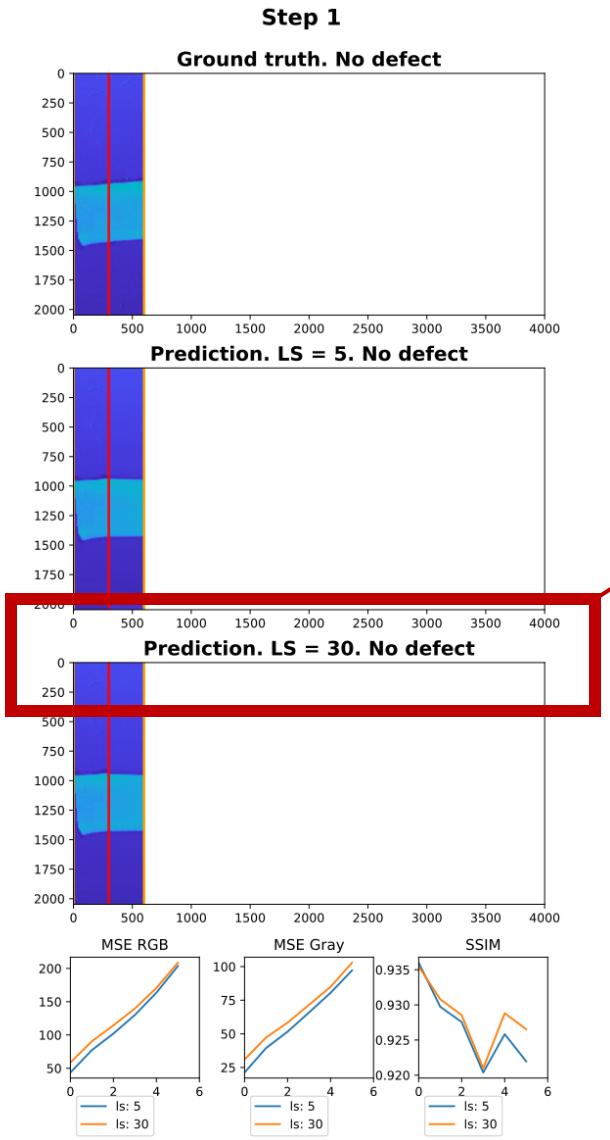
Ground truth



Encoded-decoded

Latent space 20

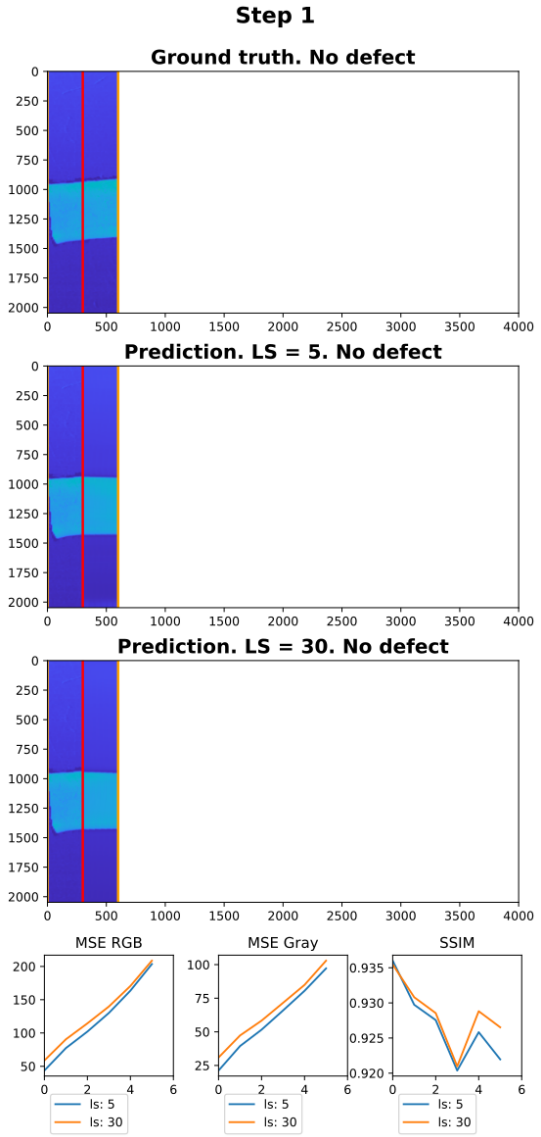
AI Defect Prediction System

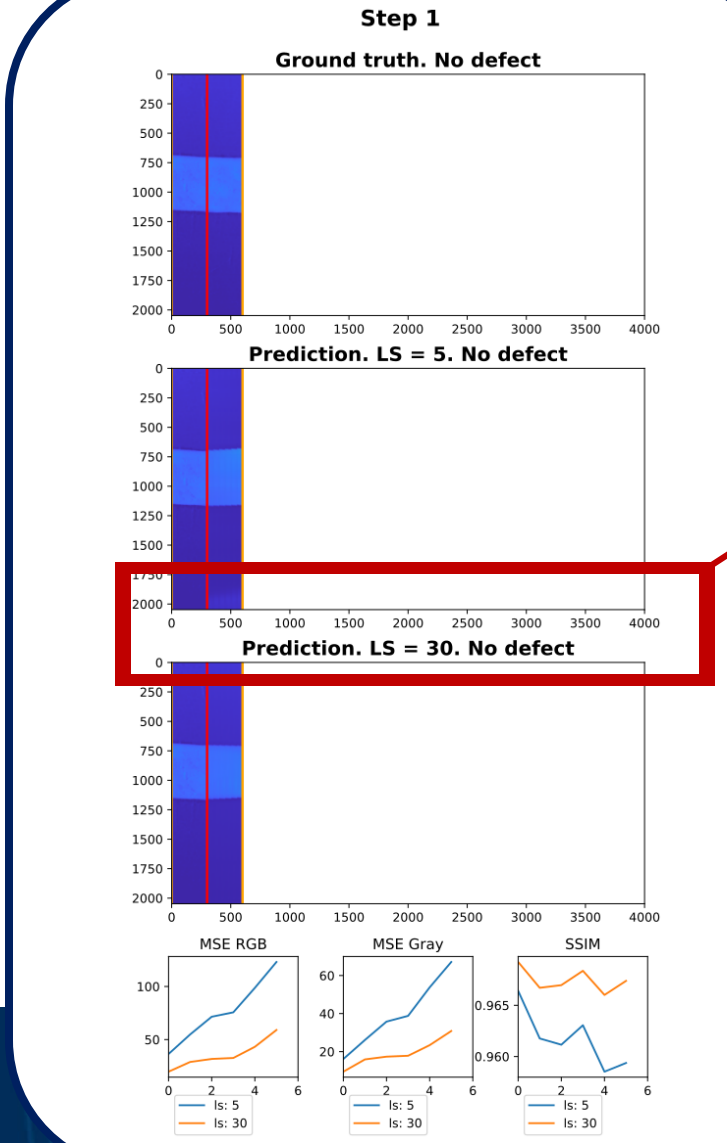


Defect is detected by laser sensor

Defect is predicted

AI Defect Prediction System





Defect is detected by laser sensor

Classification defect is predicted

THANK YOU FOR YOUR ATTENTION

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