

AI @Materialise: It takes more than training a network

Aim-Net
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About Materialise



**Materialise
Software**



**Materialise
Manufacturing**



**Materialise
Medical**

>> Delivering premium software, engineering, and 3D printing services

Additive manufacturing

- ▶ Layerwise process
- ▶ Unique geometries





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Technical drawing of eyeglasses with various annotations and handwritten notes. The drawing includes a top-down view of the frame, a side profile of the temple, and a detailed view of the hinge mechanism. Annotations include 'Texture' near the lens, 'Texture SP' near the temple, and 'Small Volume' near the hinge. A handwritten note '2/2' is visible near the top of the frame. The drawing is surrounded by various design tools: a set of colored pencils (Materialise brand) in the top left, a green textured strap (Materialise brand) in the middle left, and a set of pens and markers in the bottom left and bottom right.

Eyewear

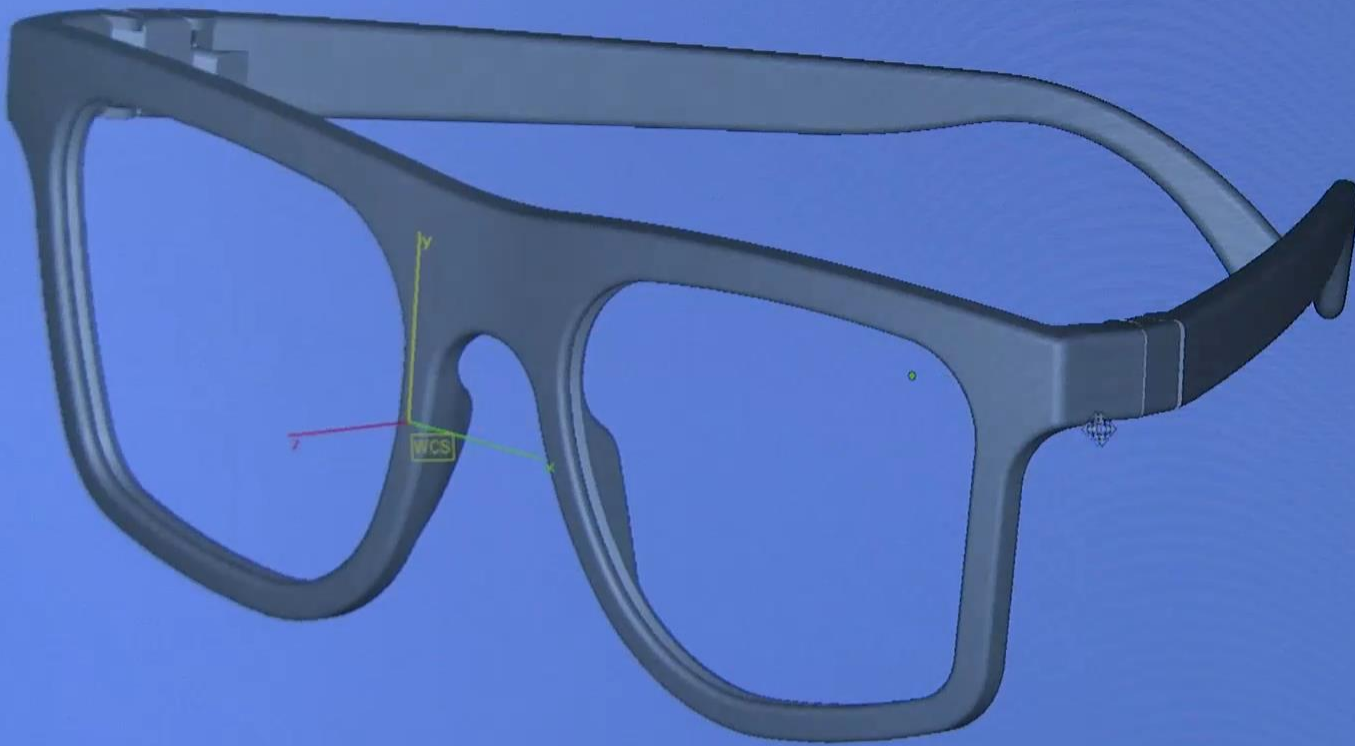


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Customization



HOYA



Build preparation





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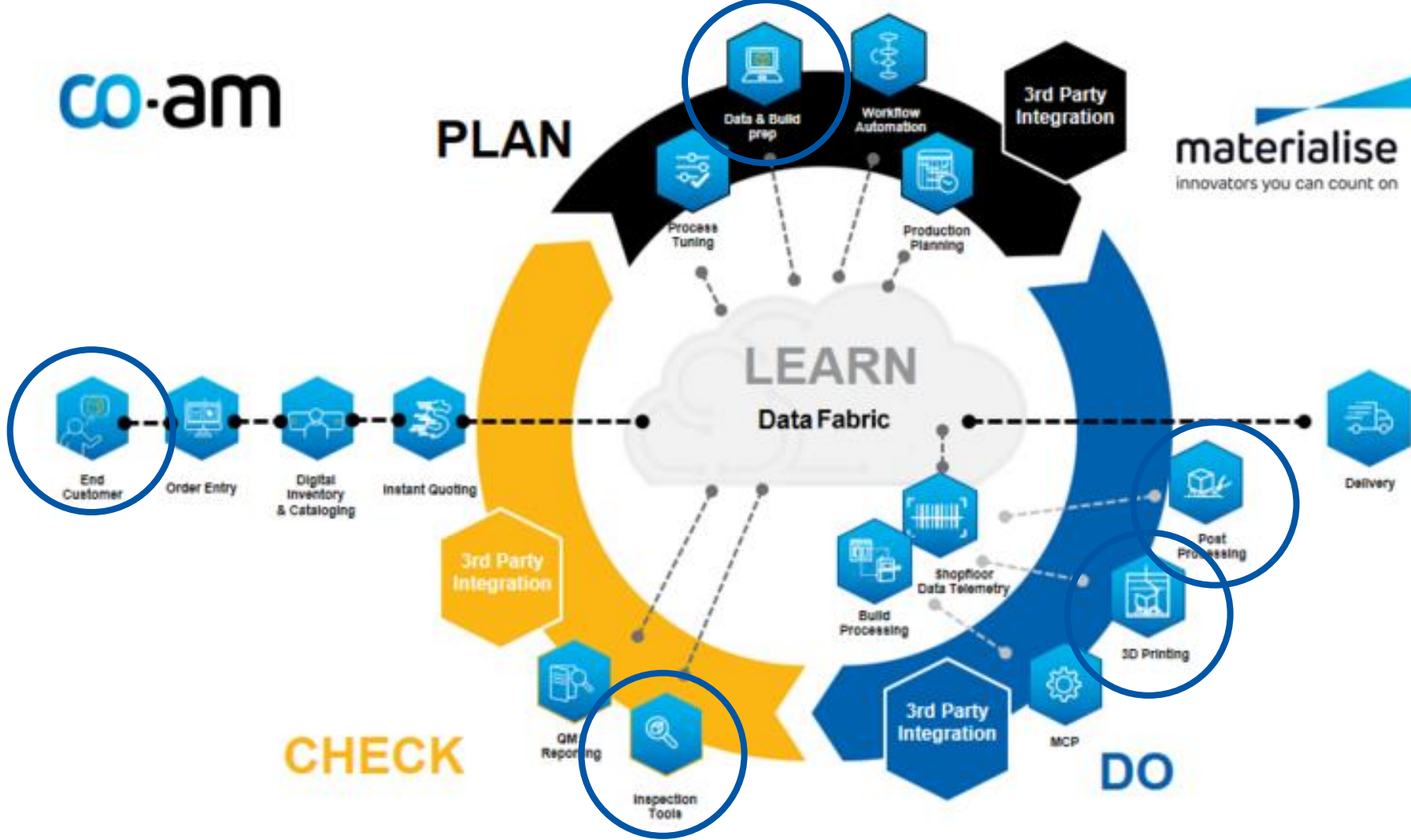
3D Printing







Quality inspection



Need for centralised data platform

- ▶ Data quality
- ▶ Traceability (not always possible)
- ▶ Missing data
- ▶ Common truth



A grayscale photograph of a metal plate, possibly a stencil or a filter, showing significant wear and damage. The plate has several circular holes arranged in a pattern, and a larger, irregular hole in the center. The edges of the holes are jagged and uneven, indicating that the material has been torn or eroded. There are also some smaller, scattered holes and marks on the surface. The overall appearance is that of a well-used and possibly abused component.

Process monitoring

overflow 0.999

debris 0.862



debris 0.930



debris 0.947



debris 0.861



debris 0.910



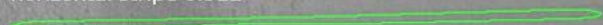
debris 0.941



gap 0.991



horizontal stripe 0.912



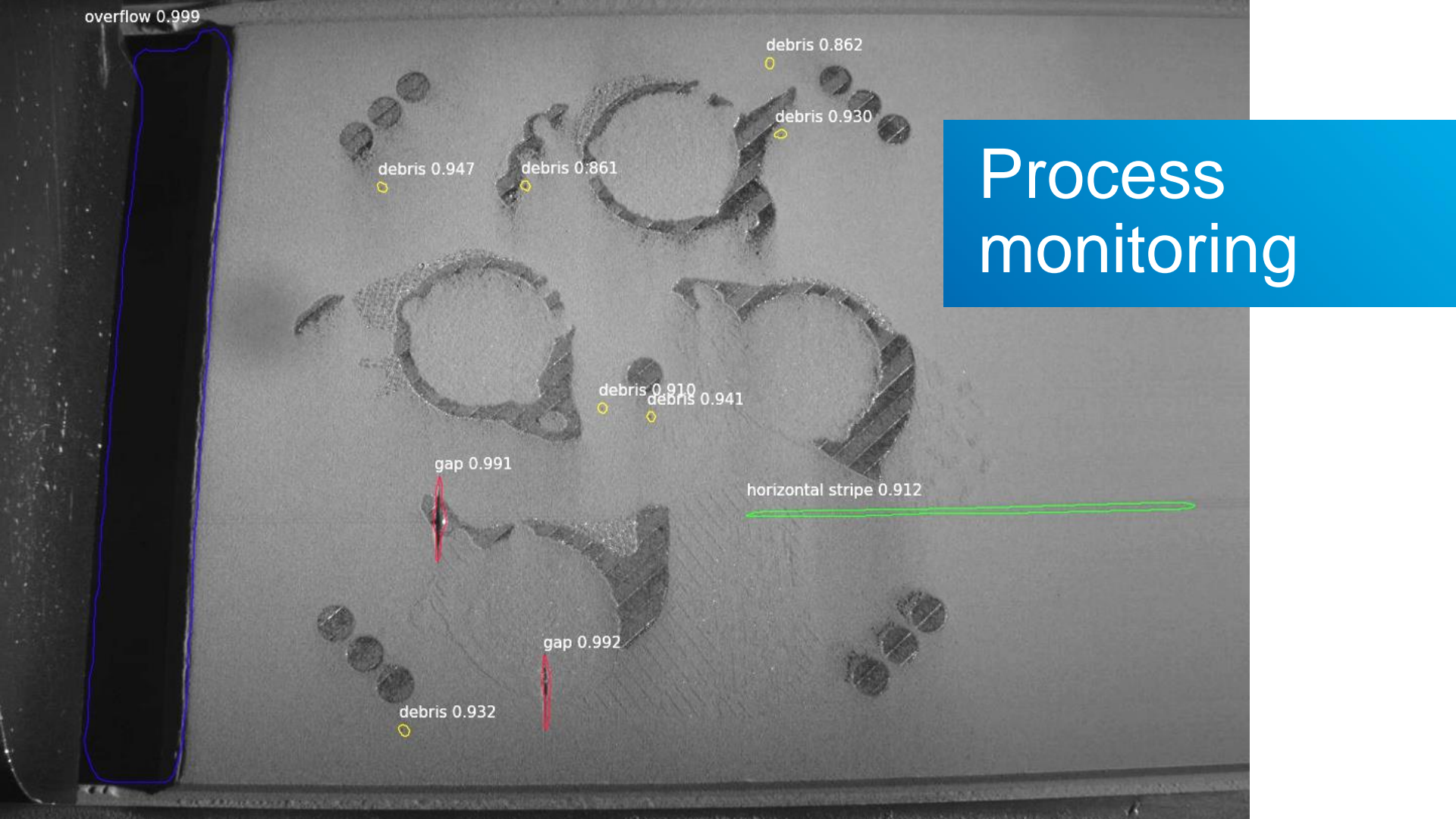
gap 0.992

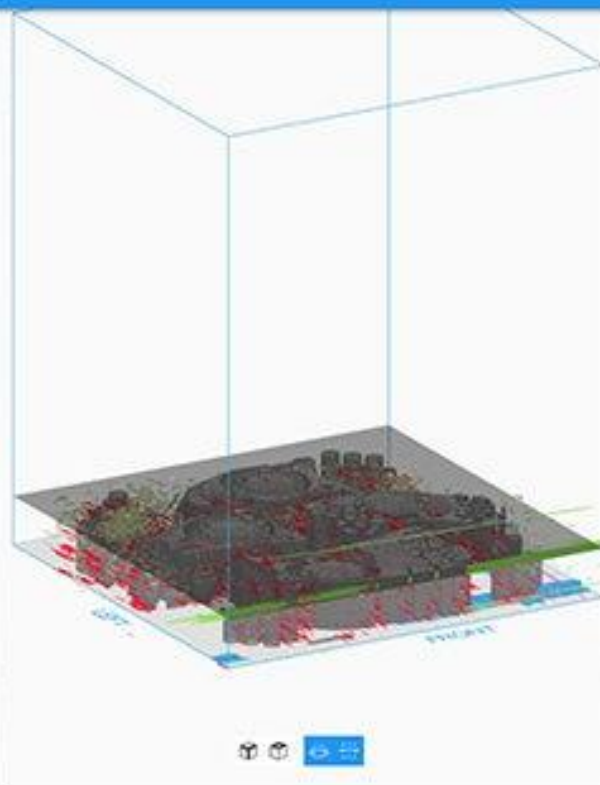


debris 0.932



Process monitoring





BUILD PARTS DEFECTS

Filters applied
Showing 4235/20130

Sort By ▾

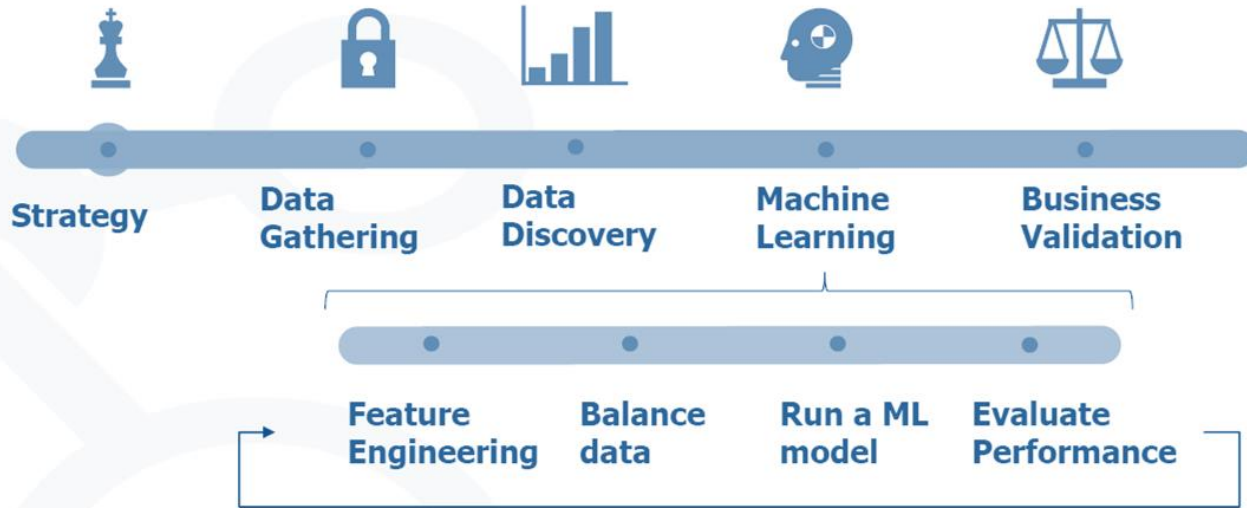
<input type="checkbox"/>	GAP0556	61%	📄	🗑️
<input type="checkbox"/>	RW0557	88%	📄	🗑️
<input type="checkbox"/>	GAP0312	90%	📄	🗑️

● Gap	<input type="checkbox"/>	● Debris	<input type="checkbox"/>
● Recoater Wear	<input type="checkbox"/>	● Recoater Hop	<input type="checkbox"/>
● Overflow	<input type="checkbox"/>	● Crater	<input type="checkbox"/>
● Elevation	<input type="checkbox"/>	● Underpowder	<input type="checkbox"/>
● Other	<input type="checkbox"/>		

Layer 996 / 2023

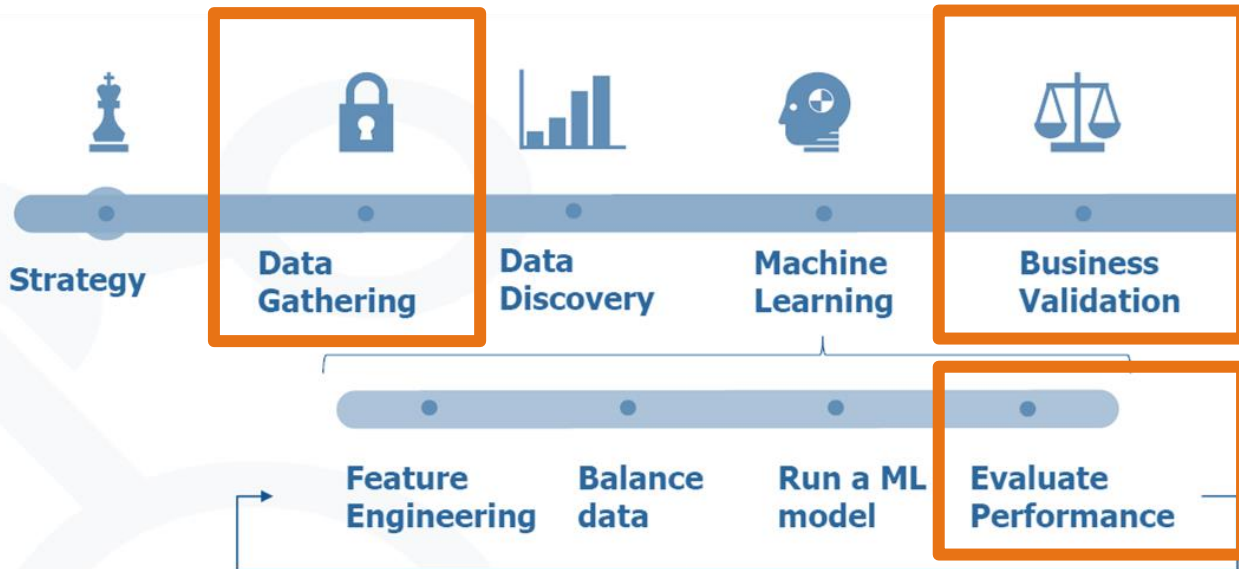
Height 29.88 / 784.69mm

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▶ Taking/Accessing images

▶ Finding and annotating defects



▶ Framework

▶ Visualizations

▶ UI

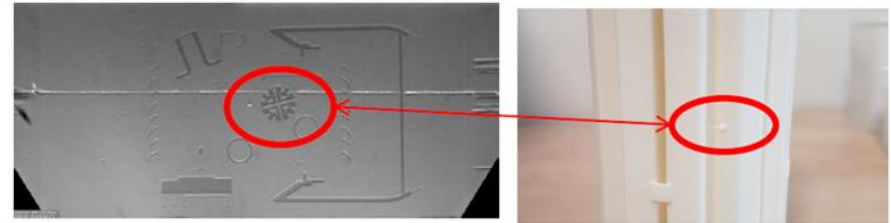
▶ Model deployment

▶ Different defects/machines/camera/lighting

▶ Independent annotations

Difficulties

- ▶ Cannot control the environment fully -> low quality datasets
- ▶ Annotated datasets are scarce
- ▶ Root cause analysis of detected defects



Layer defects **lead to...** Part defects

Understand the
relation between
layer and part defects

From manual inspection
to automated inspection

Timeseries analysis



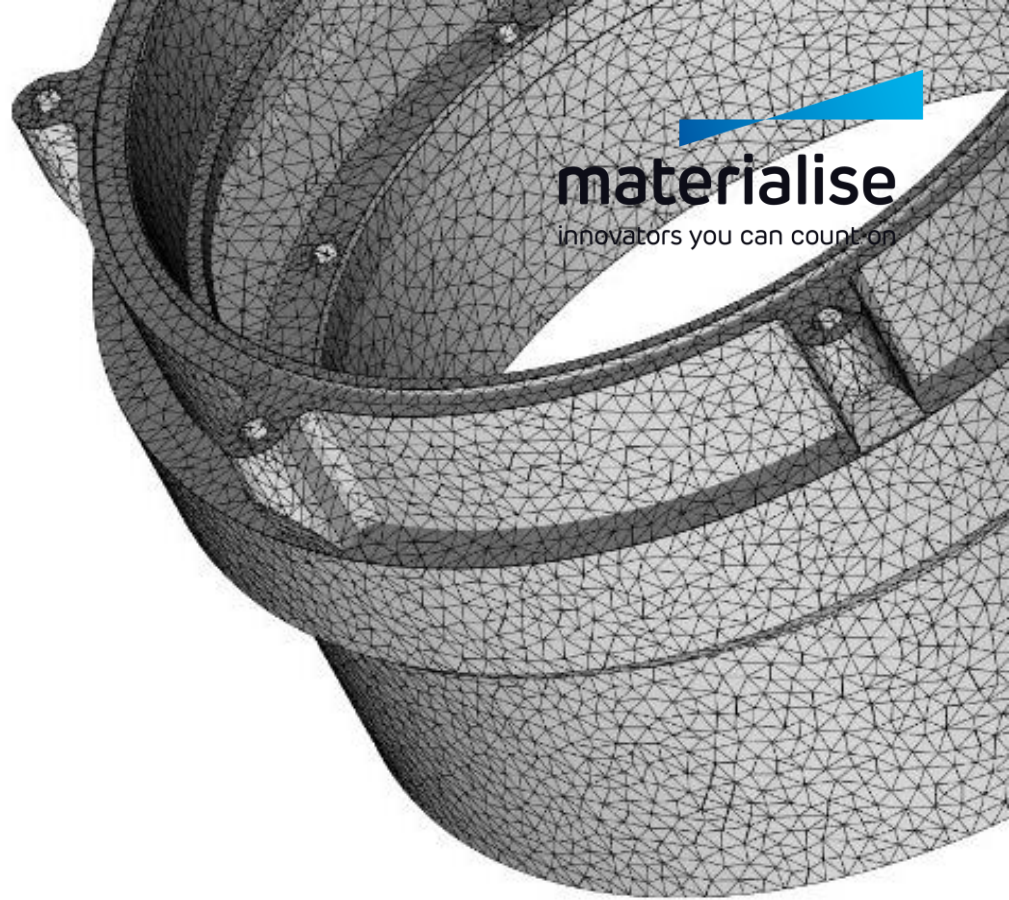
Timeseries analysis

- ▶ Unlabeled data
- ▶ Non-stationary, layer based
- ▶ Large expected variance
- ▶ Build geometry influences:
 - Layer time
 - Energy input
 - ...



Part features

- Find similar parts
- Optimize orientation
- AI for 3d objects
- Number of triangles is not fixed



It takes more than training a network

- ▶ Gathering data is expensive
- ▶ Data quality is poor
- ▶ Often rely on finetuning pretrained models
- ▶ Becoming data-driven requires a company-wide effort

Academic research that can help

- ▶ Real-world datasets

- ▶ small, semi-labeled, missing values, large variance

- ▶ Lighting conditions

- ▶ Train networks with sub-optimal lighting, create lighting conditions with tight constraints

- ▶ Frameworks for traceable and centralised data

- ▶ Variable input size for networks (timeseries, meshes)