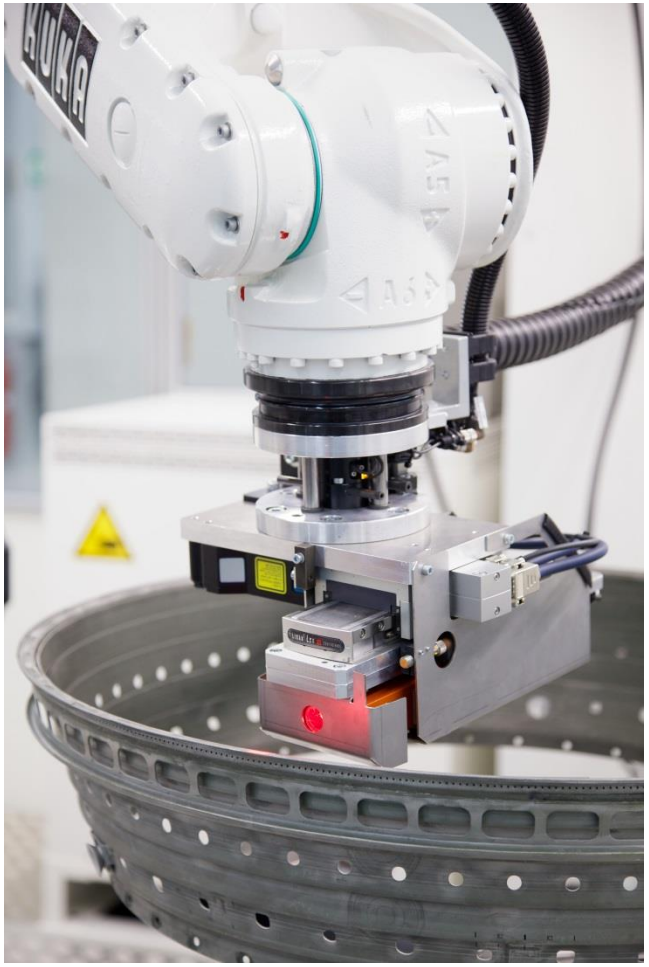
A4A NDT Forum 2016 - AutoInspect

Innovative Inspection System for Engine Components

K. Ross & M. Ernst | Engine Service | Sept. 2016

Lufthansa Technik

Content



AutoInspect – Introduction

Lufthansa Technik Group – Facts & figures

800
customers worldwide

20.289
employees worldwide*

3.680
aircraft under exclusive contracts

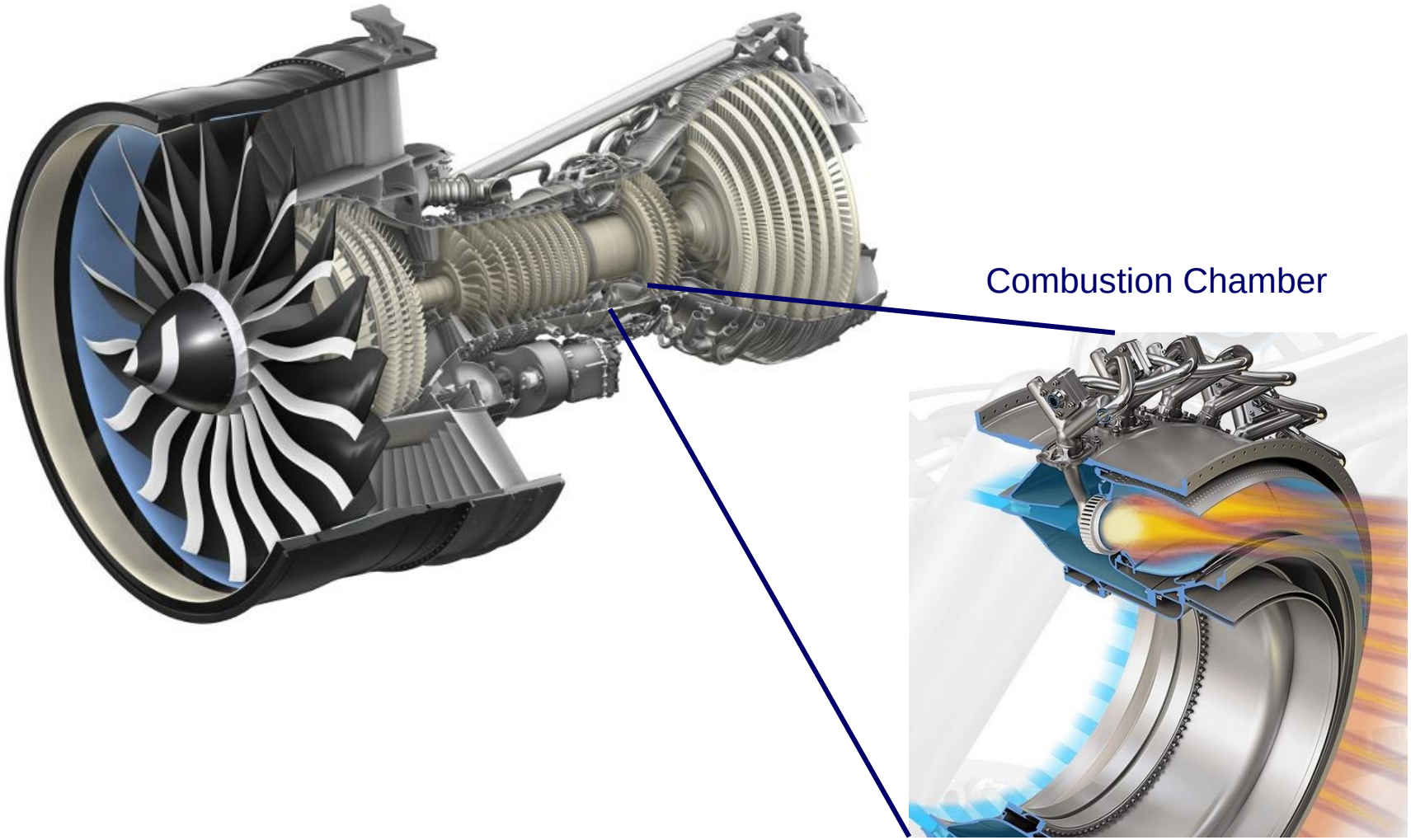
5,099 billion €
in revenue*

33
subsidiaries and affiliates worldwide

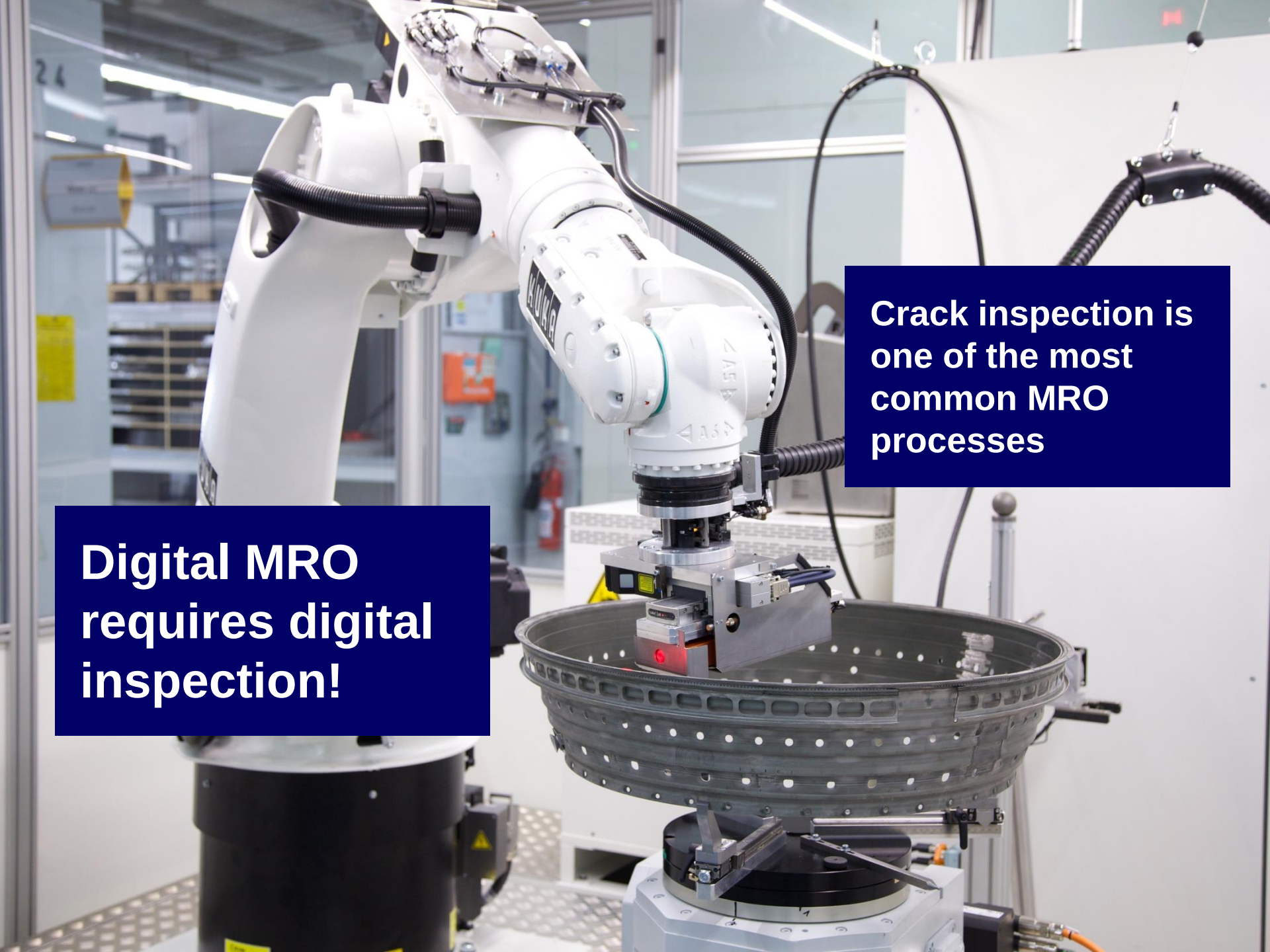
* Lufthansa Technik AG Germany and 23 consolidated companies of Lufthansa Technik Group in 2015; employees as of 31.12.2015

AutoInspect – Introduction

Where to find the combustor in the engine?



[GE]

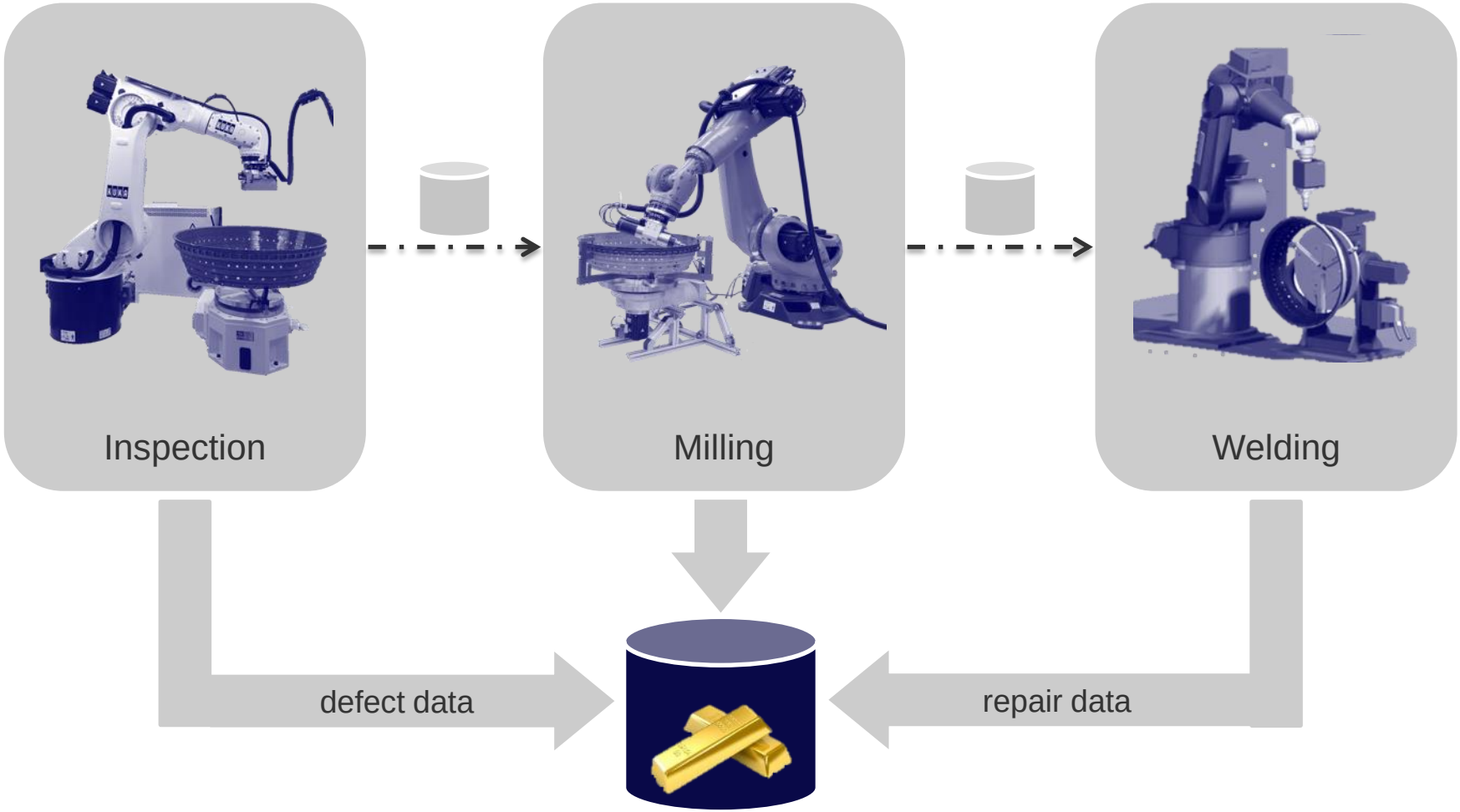


Crack inspection is one of the most common MRO processes

Digital MRO requires digital inspection!

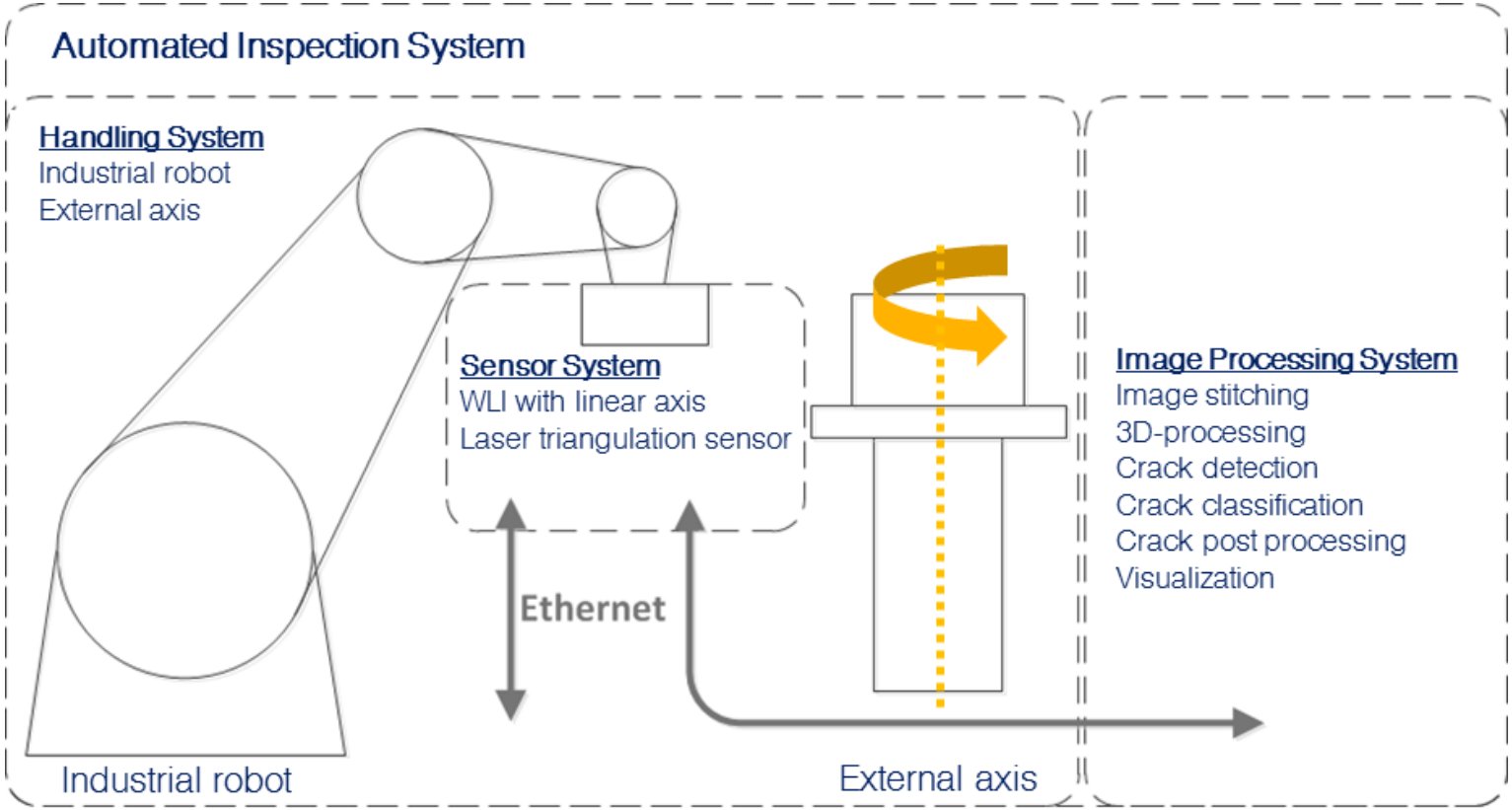
AutoInspect – Technical Overview

Goal: Automated engine parts repair



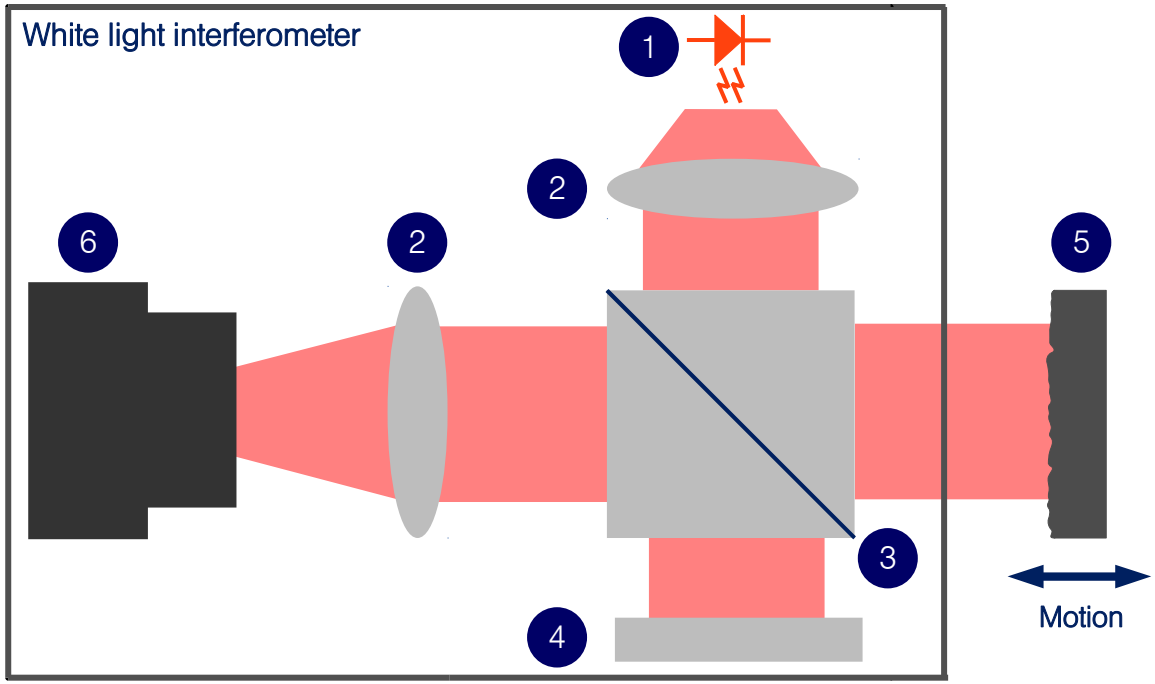
AutoInspect – Technical Overview

System Setup



AutoInspect – Technical Overview

Sensor Technology



1 IR - SLED

2 Lens

3 Beam splitter

4 Reference mirror

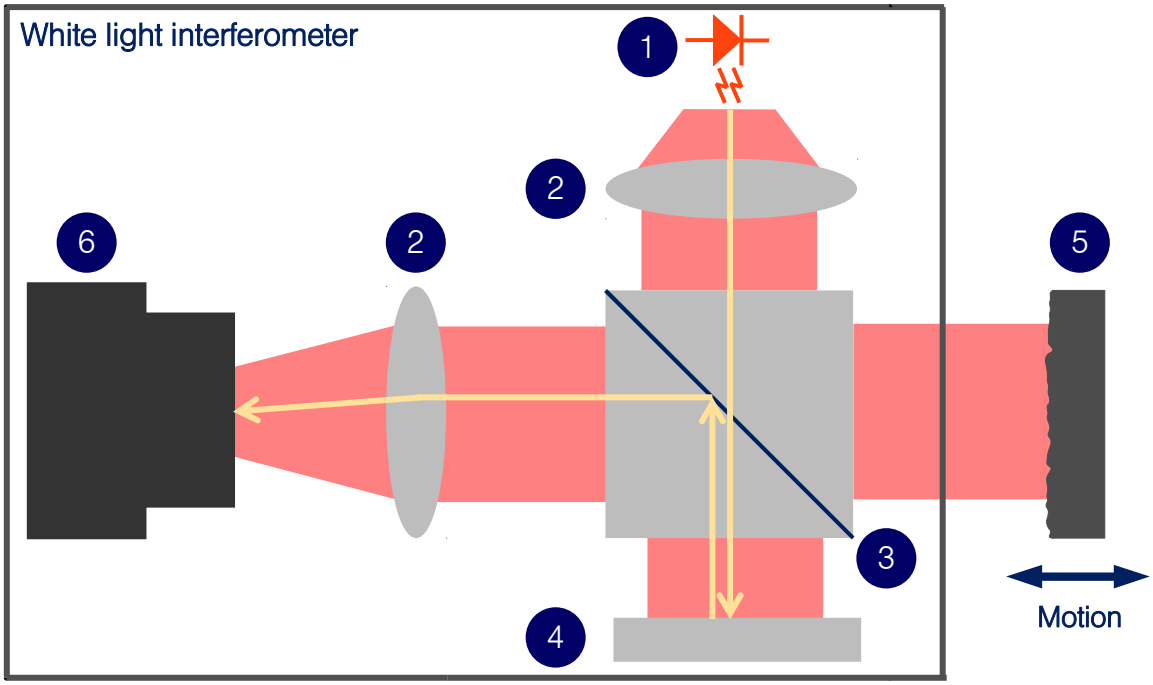
5 Device under test

6 Camera

Based on “Michelson Interferometer”

AutoInspect – Technical Overview

Sensor Technology

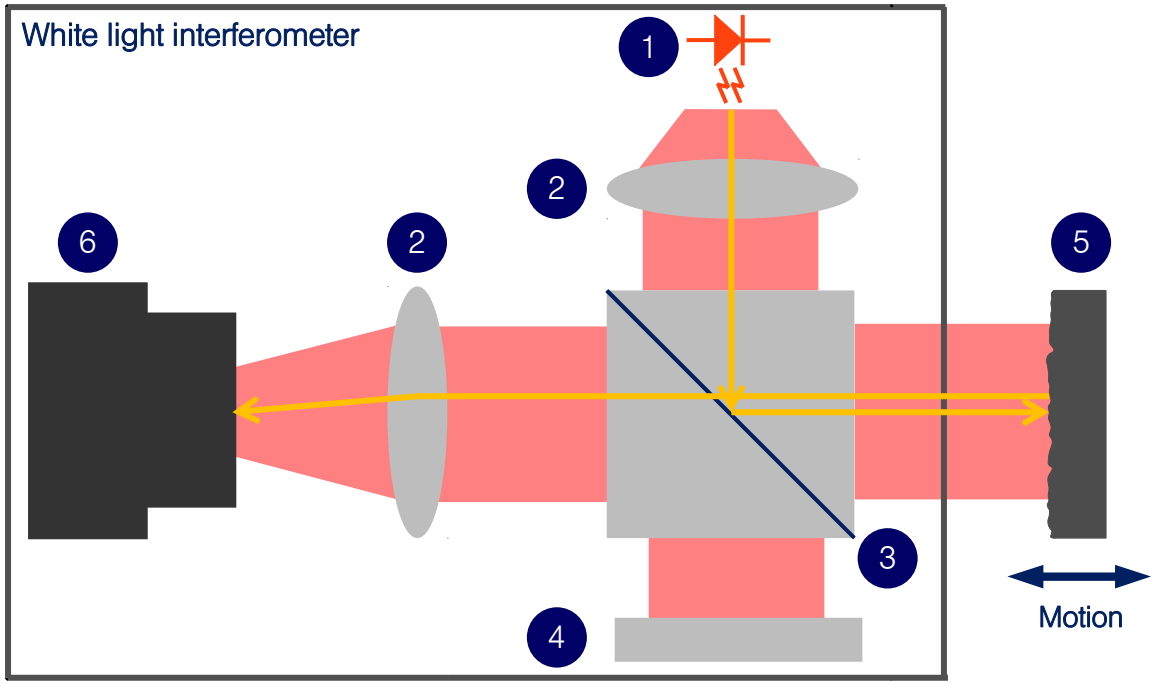


1	IR - SLED
2	Lens
3	Beam splitter
4	Reference mirror
5	Device under test
6	Camera

Path of beam #1 (reference)

AutoInspect – Technical Overview

Sensor Technology



1 IR - SLED

2 Lens

3 Beam splitter

4 Reference mirror

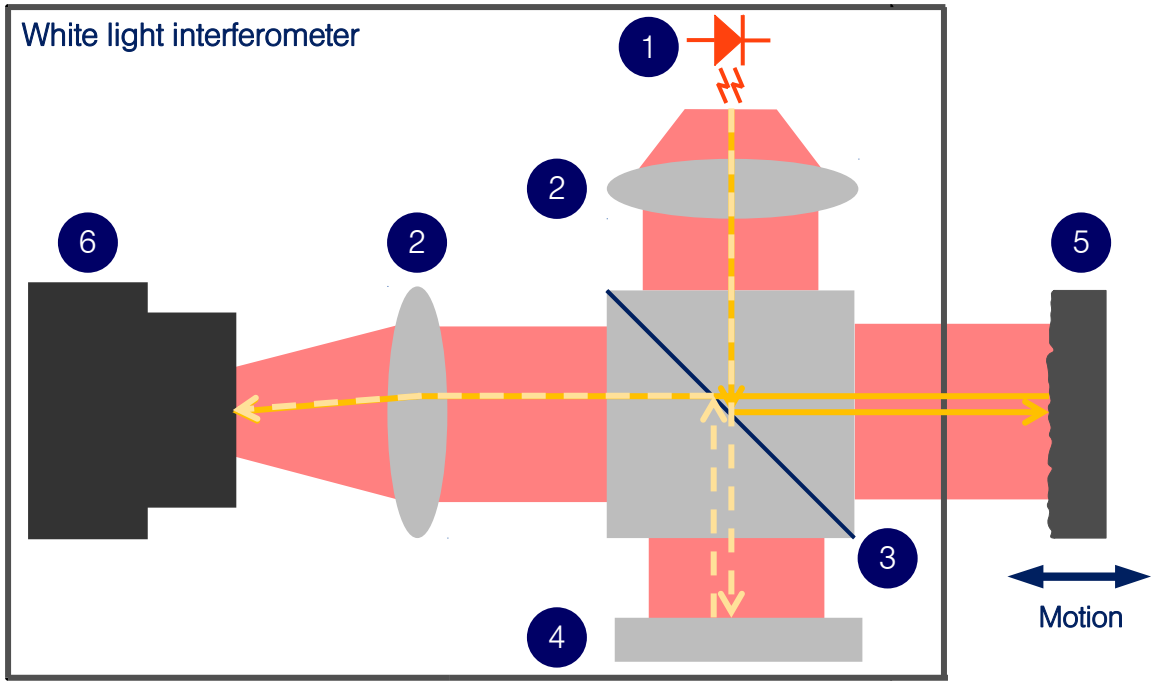
5 Device under test

6 Camera

Path of beam #2 (object)

AutoInspect – Technical Overview

Sensor Technology



1 IR - SLED

2 Lens

3 Beam splitter

4 Reference mirror

5 Device under test

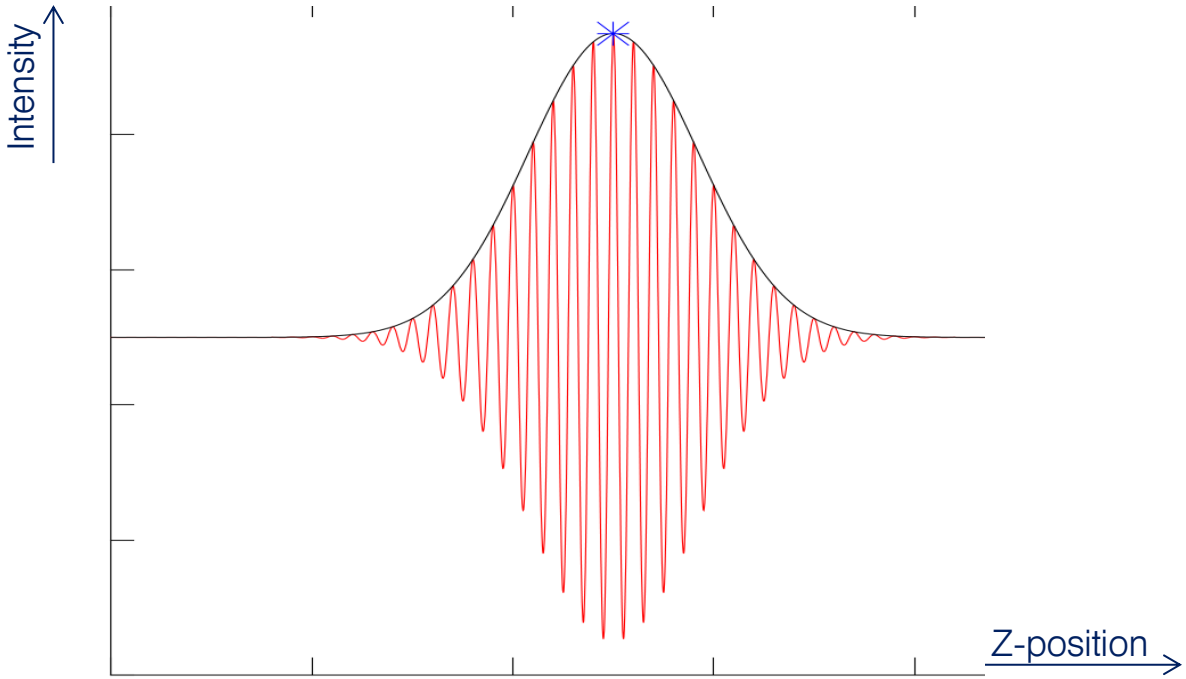
6 Camera

Movement in z-direction

Optical path difference < coherence length → Interference

AutoInspect – Technical Overview

Sensor Technology



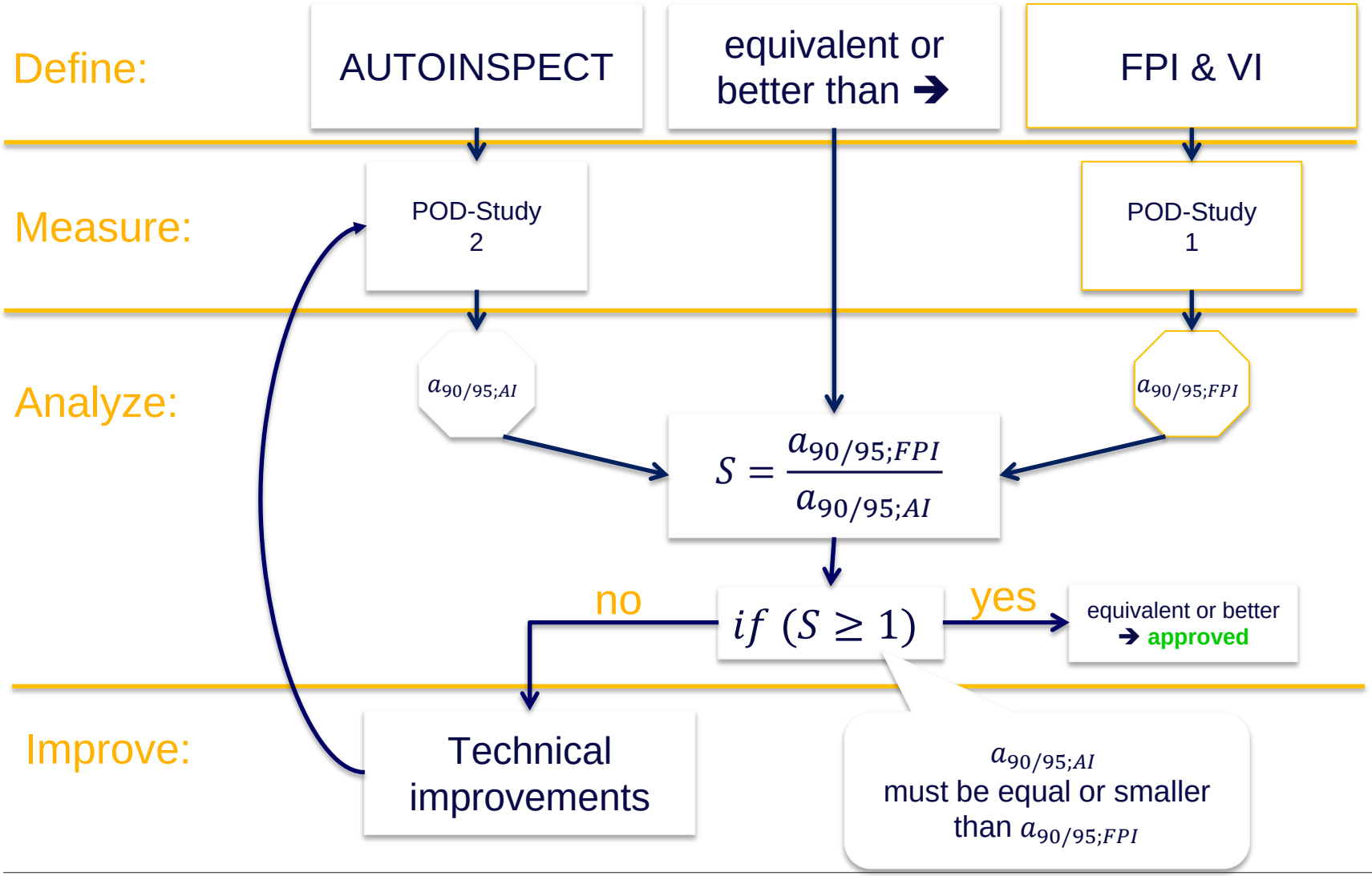
Demodulation → Envelope

Detection of maximum intensity → Distance to object

moving through scan range → z-distances/intensity for every pixel

AutoInspect – System Qualification

How to compare physical different working NDT systems?

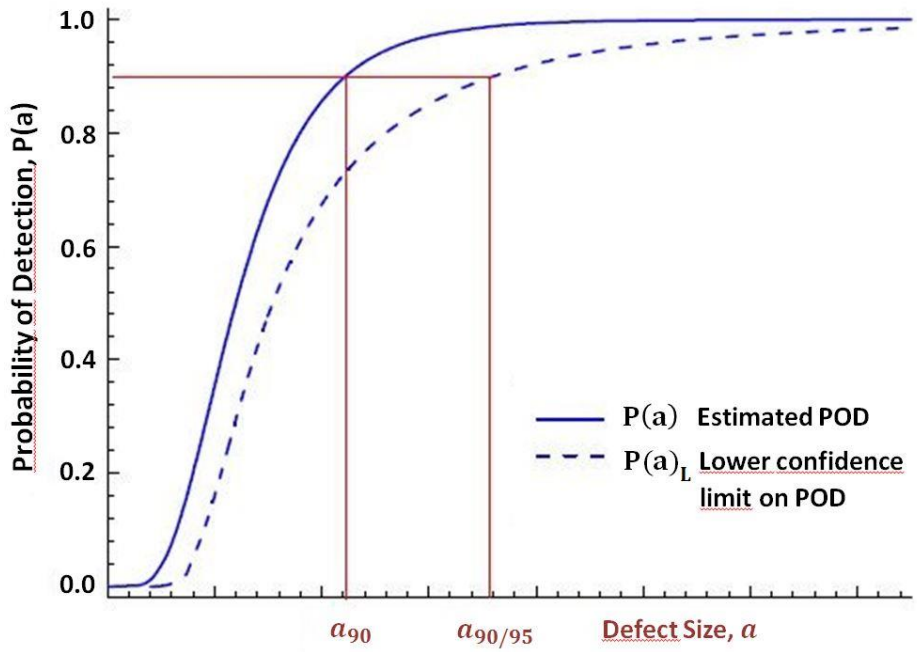


AutoInspect – System Qualification

Experimental requirements to produce POD curves

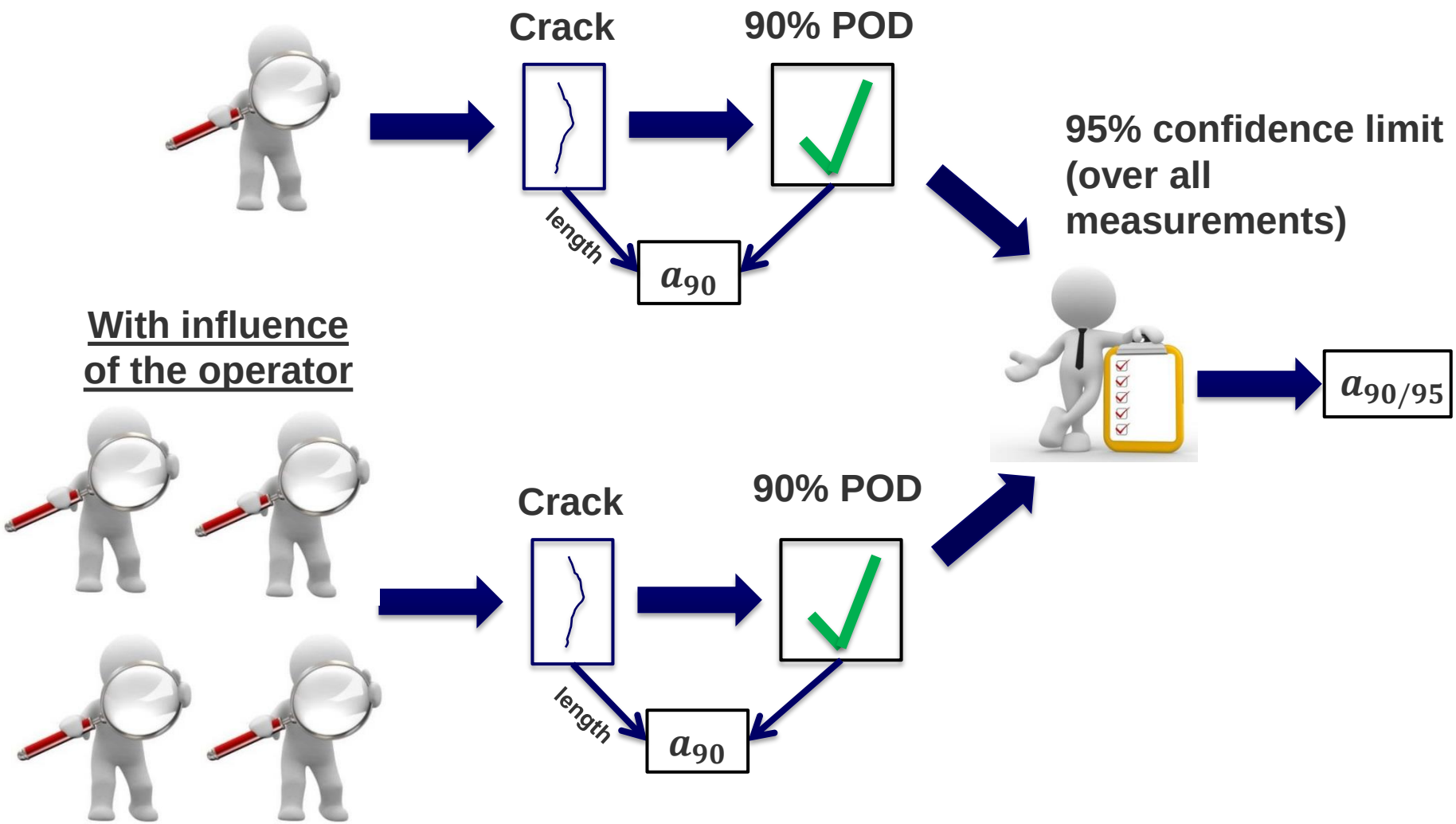
a_{90}: crack length, which is detected with a probability of 90%, i.e. $P_{(a_{90})} = 0{,}9$

$a_{90/95}$: crack length, which is detected with a probability of 90% and confidence limit of 95% over all measurements, i.e. $P_{L(a_{90/95})} = 0{,}9$



AutoInspect – System Qualification

Experimental requirements to produce POD curves



AutoInspect – System Qualification

Watch out for common pitfalls using POD!

- **Underestimating the influence of sample geometry on POD performance**
- **Underestimating the influence of informed/uninformed inspectors on POD performance**
- **Wrong definition of crack size distribution during POD experiment**
- **Deleting “outliers” that do not “fit” to other inspection results**

Recommendation:

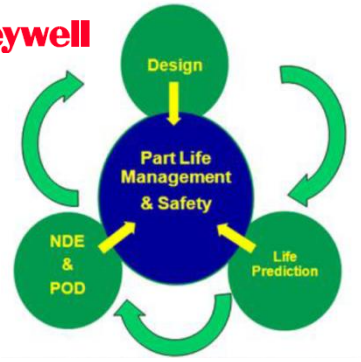
Study POD literature or consult POD experts before conducting any experiments!

AutoInspect – System Qualification

Summary POD

- POD method is the industry standard for qualification of new NDT systems
- POD method is the best way to consider the random nature of inspection processes
- POD method creates transparency of inspection system performance
- POD method allows a comparison of physically different inspection systems (unlike R&R)
- POD method is compatible to DTD and fits nicely into Part Life Management

Honeywell



ASTM INTERNATIONAL
Standards Worldwide

ASTM E2862

DEPARTMENT OF DEFENSE HANDBOOK

NONDESTRUCTIVE EVALUATION SYSTEM RELIABILITY ASSESSMENT

MIL-HDBK-1823A
7 April 2009

Any questions?

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