Quality assurance as a tool for the standardization of new technologies using the example of laser process, such as DLMS

INDTECH 2018

Workshop „Photonics 4 Industrial Production"

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plasmo International GmbH

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overview

- Company plasmo

- Challenges

- 3D metal printing 2 basic technologies Powder Bed Fusion and DED (Powder, Wire)

- Inline process control for DLMS and LMD

- Future outlook

Quality Assurance for
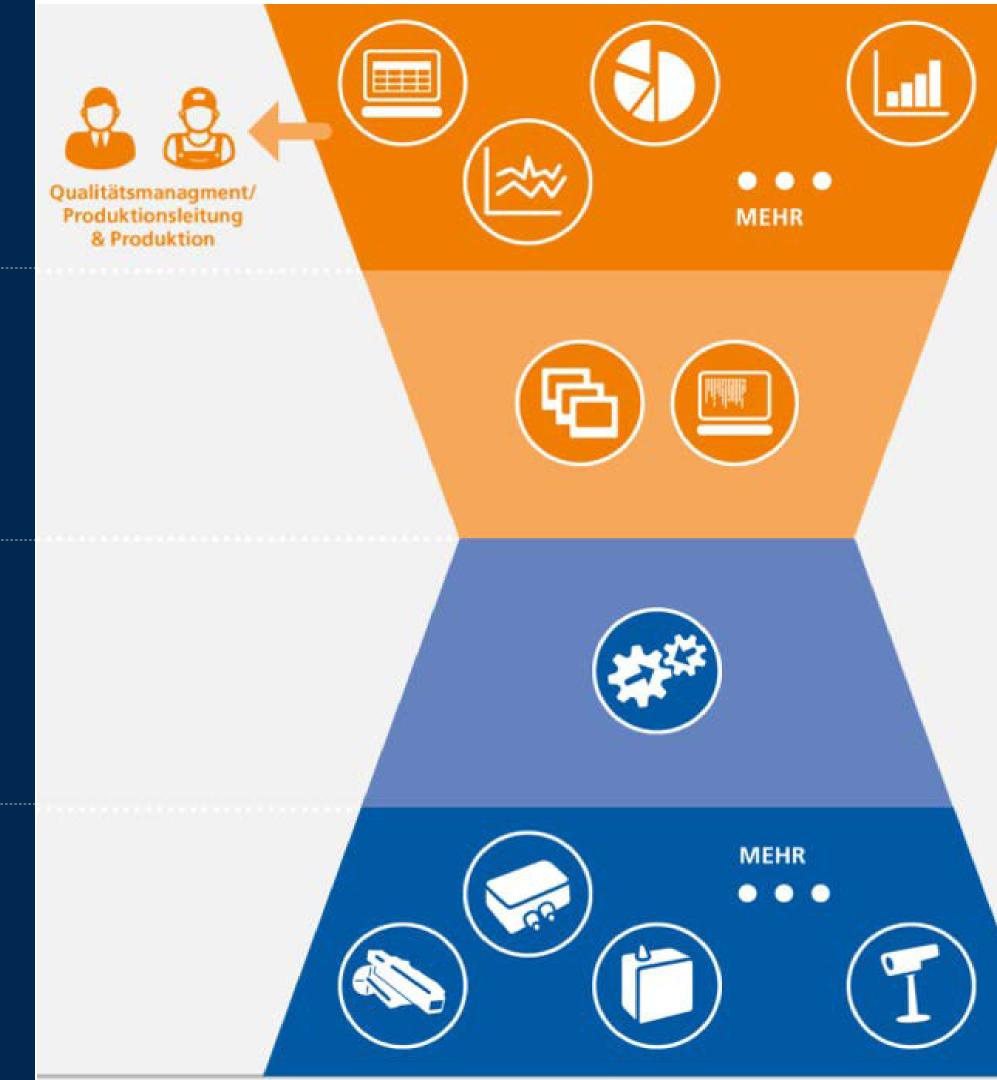Automated Welding and Laser Processes.

fast. tailor made. independently.

plasmo Quality Suite.

- visualization

- Correlation

- Integration

- Sensorik

Qualitätsmanagment/
Produktionsleitung
& Produktion

MEHR

MEHR

global. focused. independent.

700

more than 700 plasmo systems
in operation

100
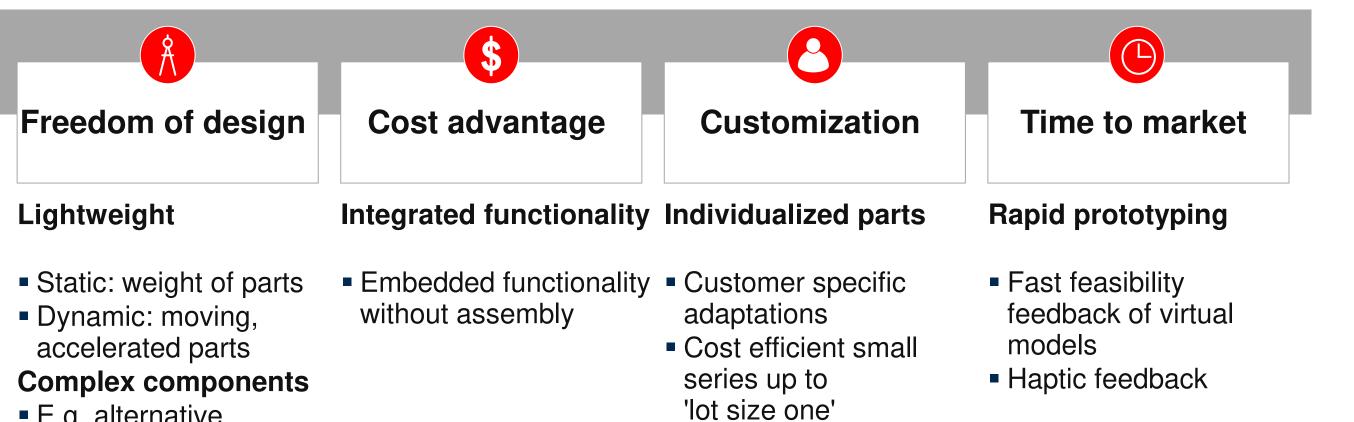
more than 100 global customers
using plasmo

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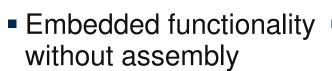
additive manufacturing
PBF: value for the customer

Freedom of design	Cost advantage	Customization	Time to market

Lightweight

- Static: weight of parts
- Dynamic: moving, accelerated parts

Complex components

- E.g. alternative structures of heat exchangers

Integrated functionality

- Embedded functionality without assembly

Individualized parts

- Customer specific adaptations
- Cost efficient small series up to 'lot size one'

Rapid prototyping

- Fast feasibility feedback of virtual models
- Haptic feedback

Source: EOS

Technology challenges AM for a fast raising market

Why has technology just begun to get started?

- o Very complex process
- o Some of the technologies are recently available
- o Because of highly individualization (e.g. Medicine)
- o Up to now, machines can only be run by experts
- o Some of the technologies still not in a wide field available
- o As for E.G. QS-Systeme:
- o During long building process, make sure everything is OK.

Challenges
for QS-System – requirements

Even if the process is very stable and it is repented by a expert, it needs typical between 10-50 hours to build a complete part.

During this time you have to me sure, that the most important characteristics and parameters are in the limits.
These are for metal:
o Temperature
o Geometry
o Stability of Process parameter
o Machine Parameters
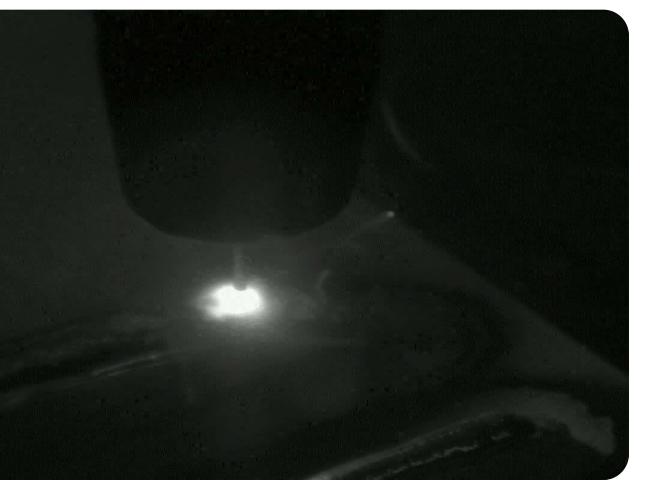
additive manufacturing technologies

PBF (powder bed fusion)		DED (direct energy deposition)
0.5 m³	working space	several m³
laser, eBeam	energy sources	laser, eBeam, CMT, plasma
100-200µm	structural size	mm
100µm	accuracy	200µm

Key technologies for QS at 3D Printing

o   Geometry measurement : profil**observer**

o   Temperature measurement : plasmo**eye**
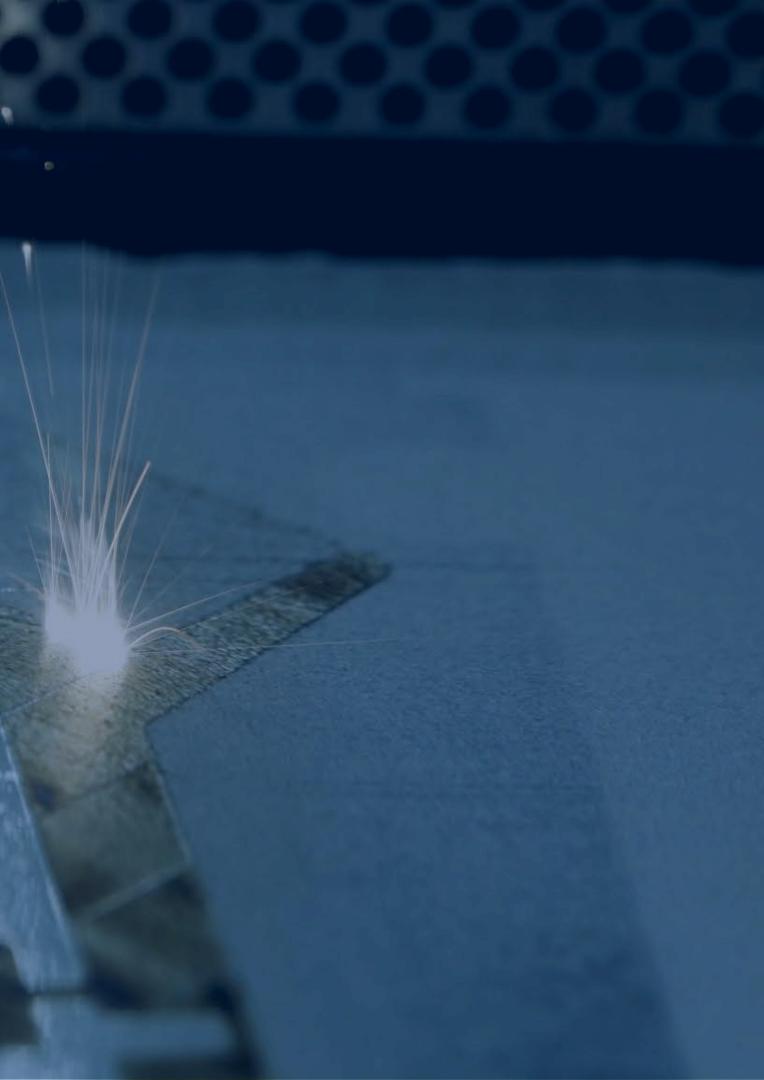
o   Process parameter: process**observer**

o   Machine Data: **plasmo Suite**

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Technology
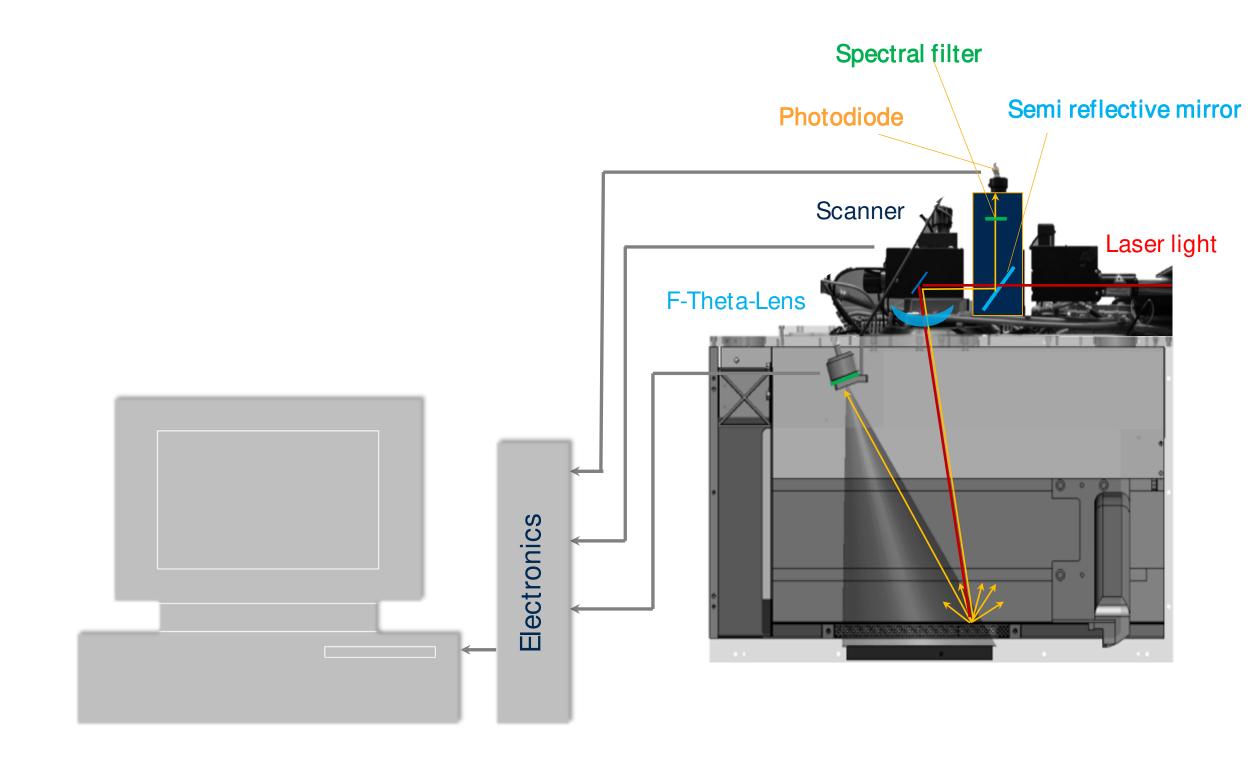
Powder Bed Fusion
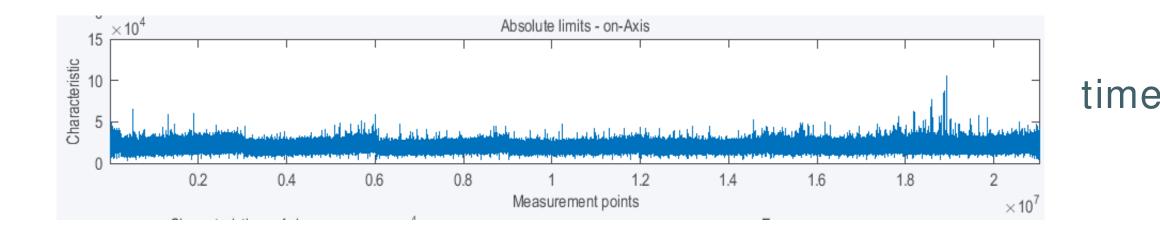
diode based process monitoring
EOSTATE Meltpool Monitoring

Spectral filter

Photodiode

Semi reflective mirror

Scanner

Laser light

F-Theta-Lens

Electronics

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EOSTATE Meltpool Monitoring
evaluation of one image per layer

time series- / spatial representation

Adding position information
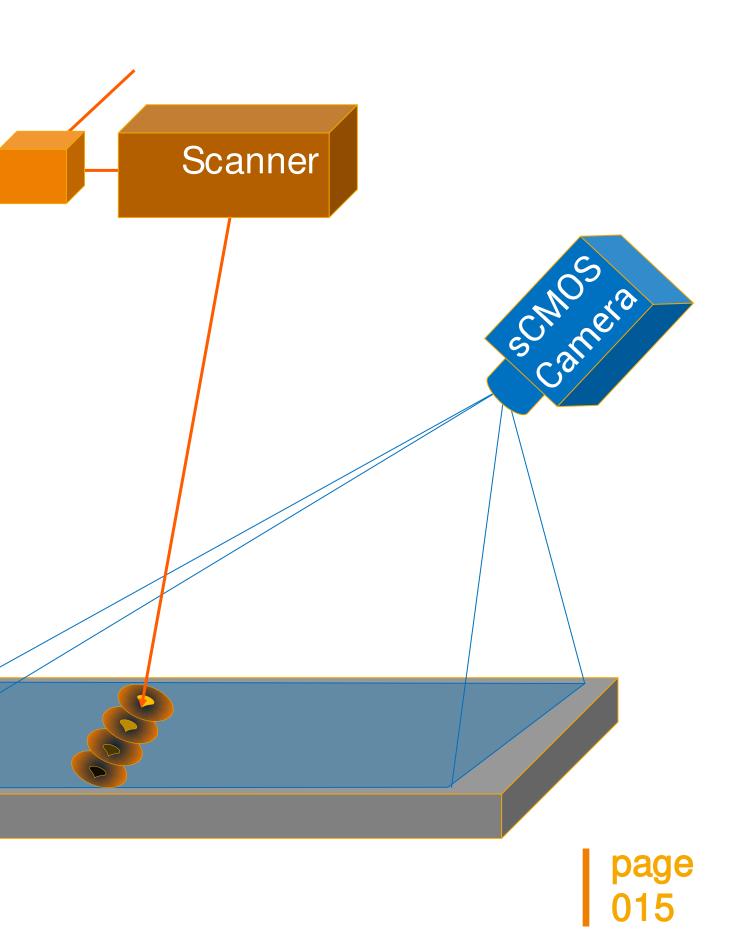
camera based process monitoring (NIR) EOSTATE Exposure OT
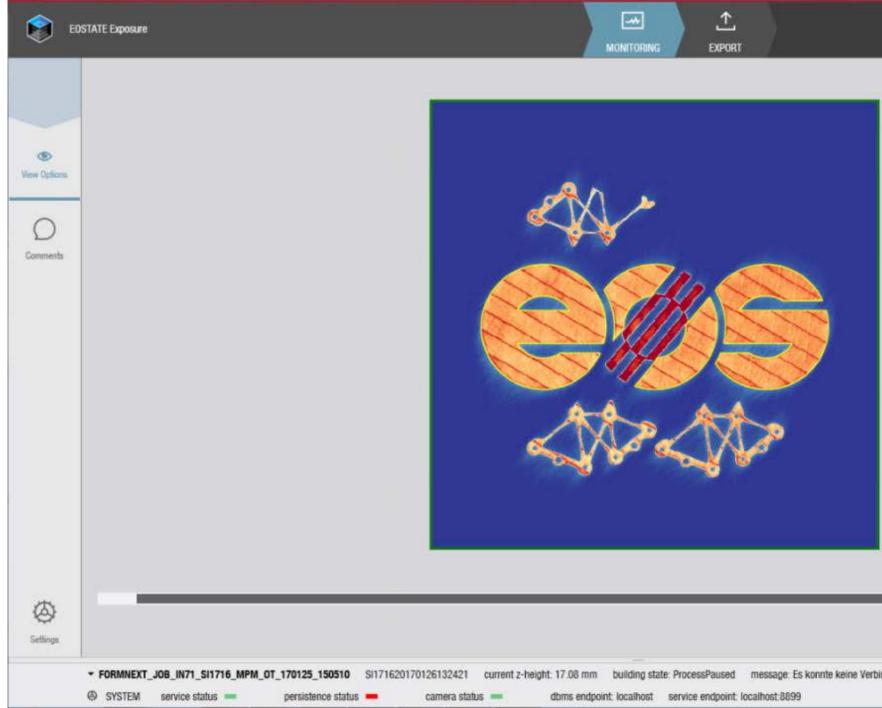
for PBF processes/
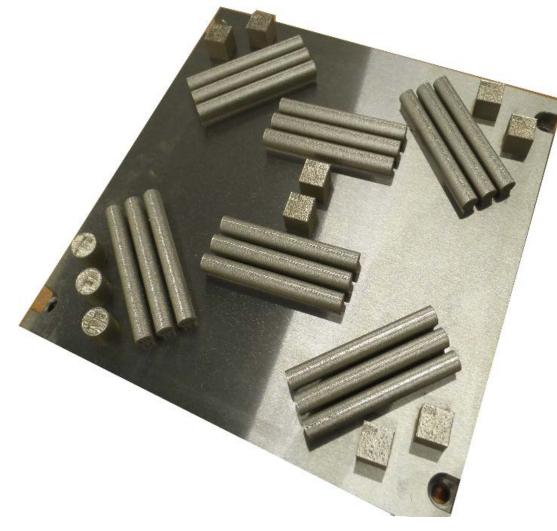worldwide first prooven tool for QA (MTU)

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EOSTATE Exposure OT
role dependant software

example variation focal position

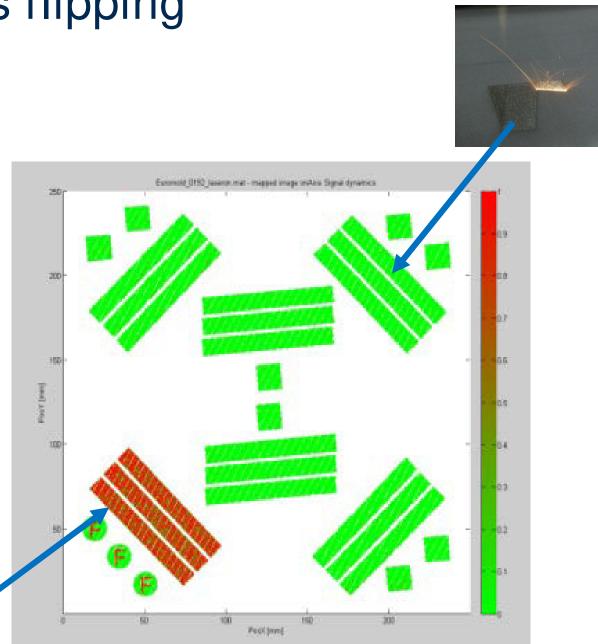detection of provoked irregularity process flipping

image of building platform
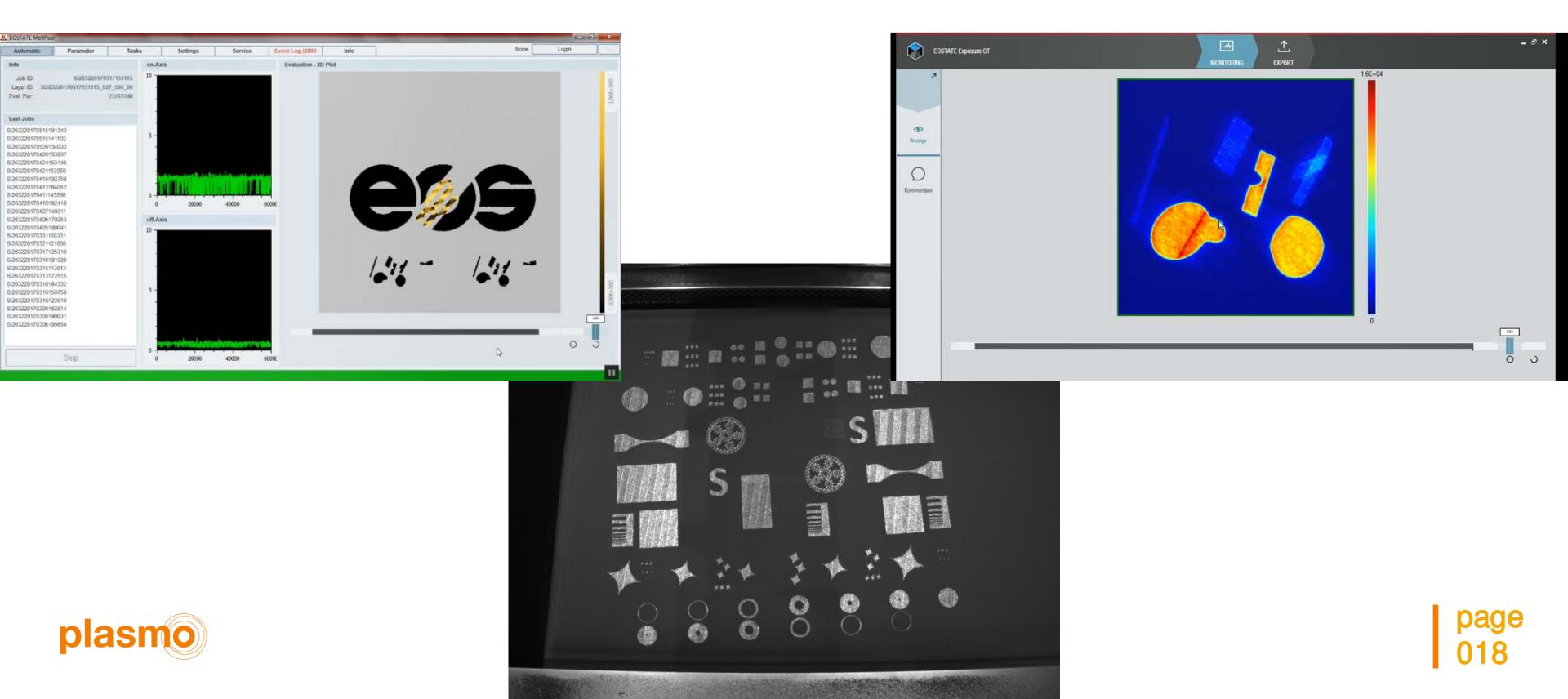after complete build

fraction of irregularities
after exposure of one layer

EOSTATE Monitoring Suite
Meltpool – PowderBed – Exposure OT - System

EOSTATE Monitoring Suite
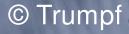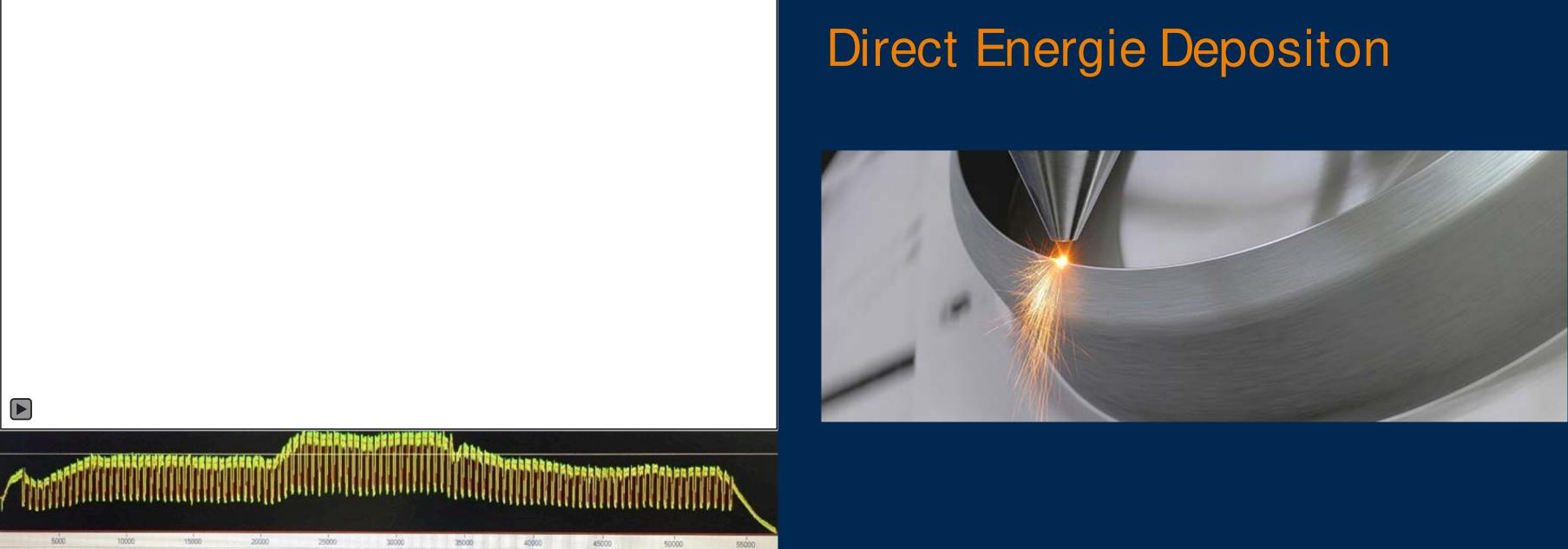## Meltpool – PowderBed – Exposure OT - System
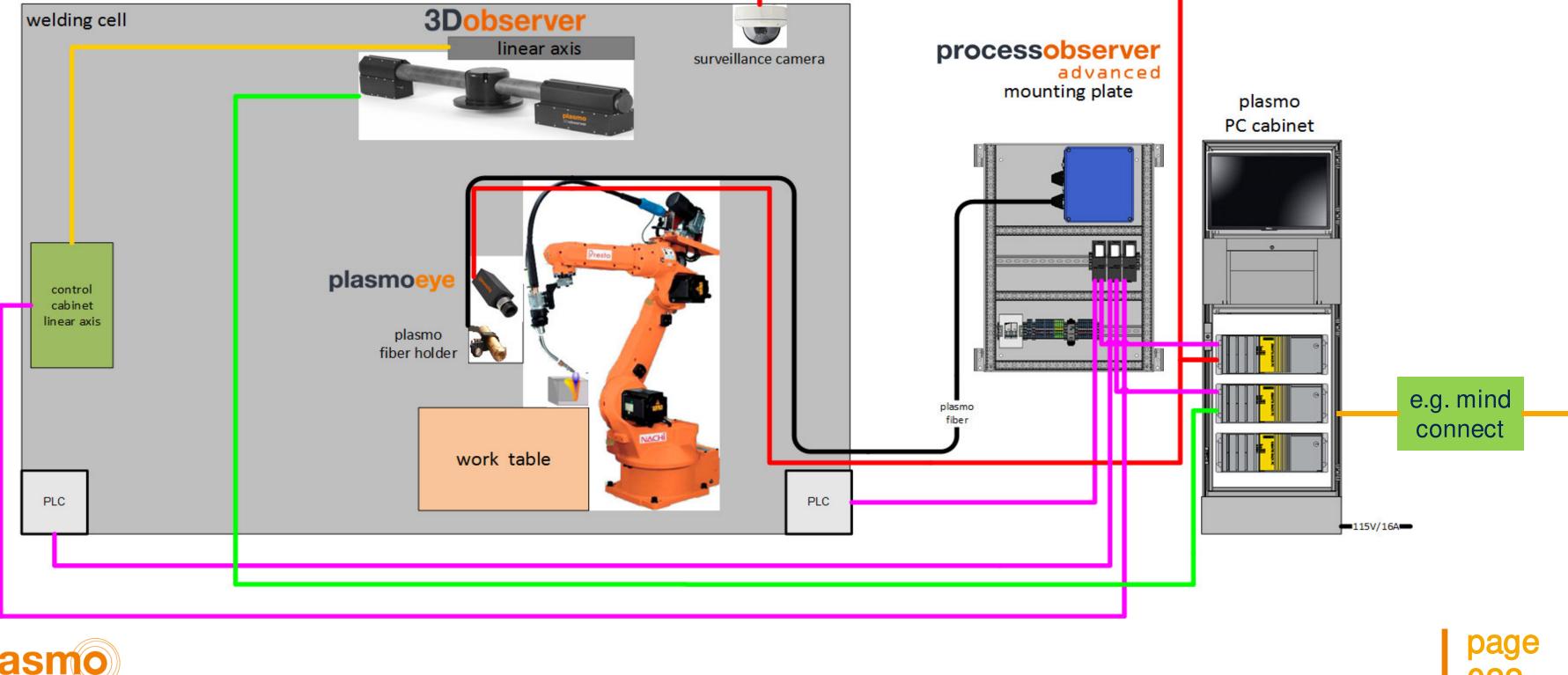
Source:
EOS

Technology

DED Direct Energy
Deposition

© Trumpf

DED
2 basic technologies, 4 concepts

Direct Energie Depositon

combined system for DED – magic box
processobserver plasmoeye 3Dobserver, machine data recording
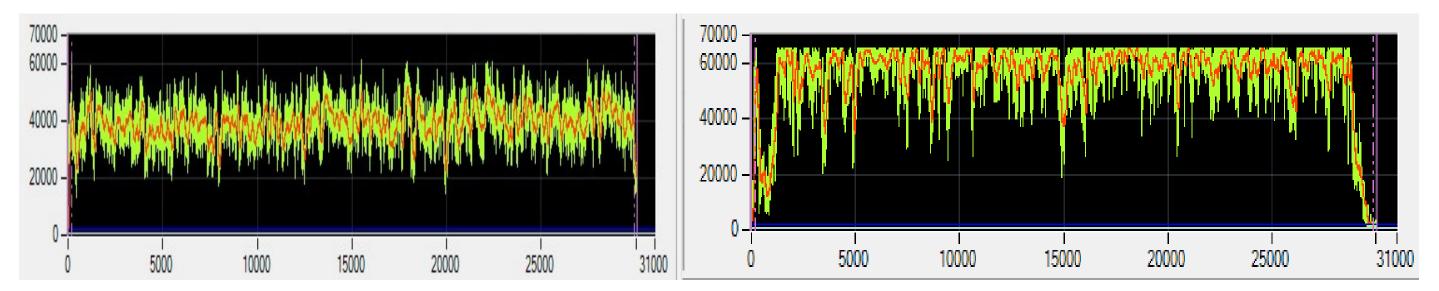
process**observer**- LMD AM

- Real time process monitoring

- AM process monitored with the plasmo process**observer**

- The results are different because of the direction changes within the process

- Solution: coaxial process head integration

- Signals are different because of one is filtered and the other unfiltered. Changing direction matters also for the signal noise

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example diode based meltpool monitoring
plasmo **processobserver**

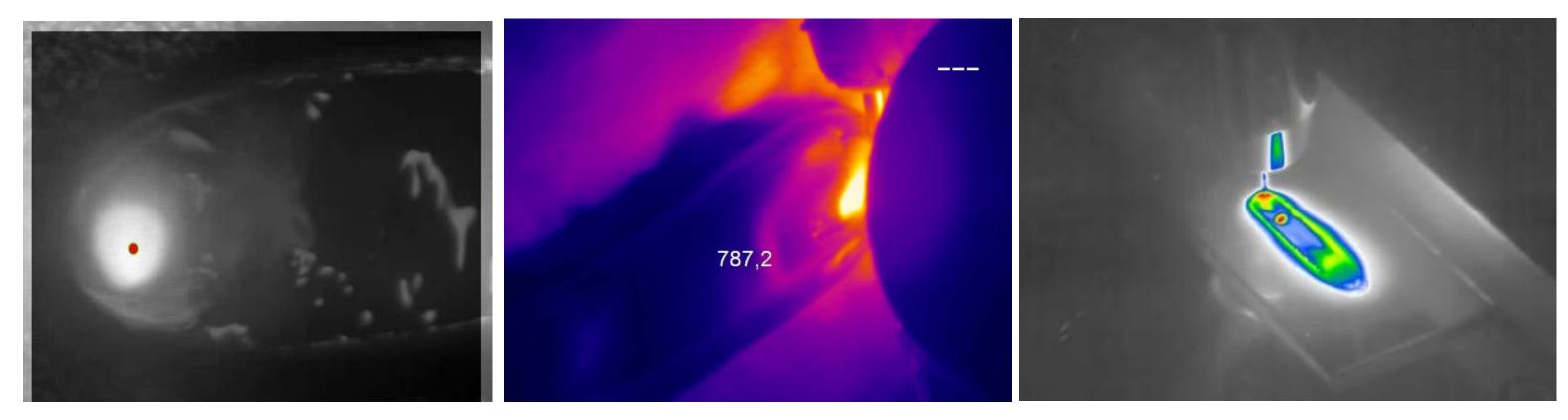documentation

detection of process anomalies and deviations

baseline layer reference with correct powder flow

powder flow changed

example camera based meltpool monitoring
plasmo**eye**

documentation

root cause analysis

visible

NIR (SWIR)
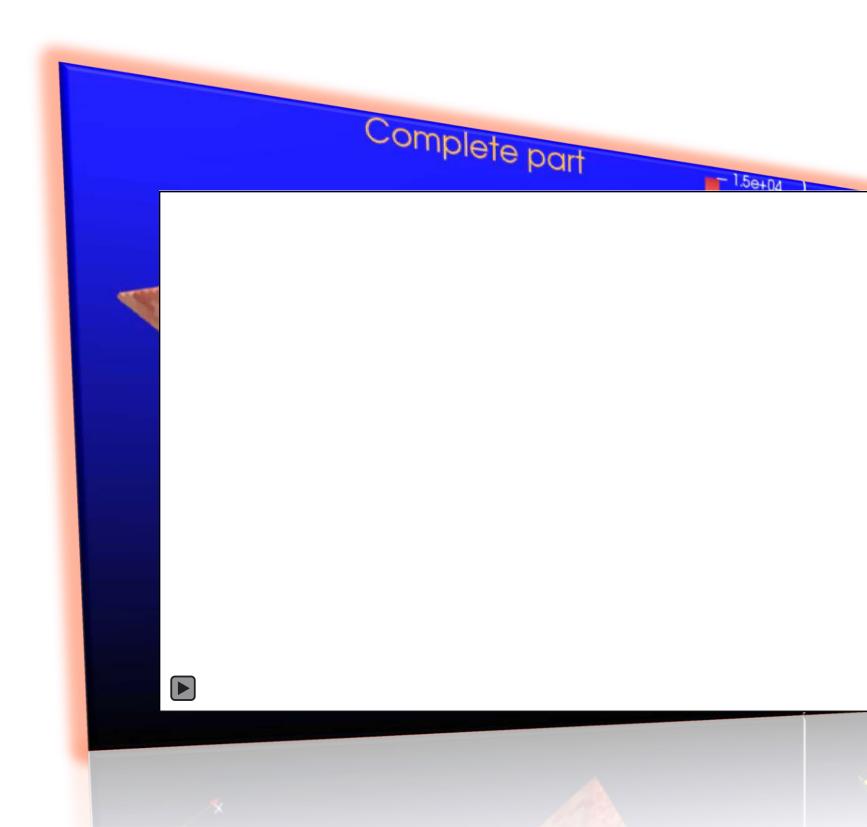
MWIR, LWIR

Source Infratec

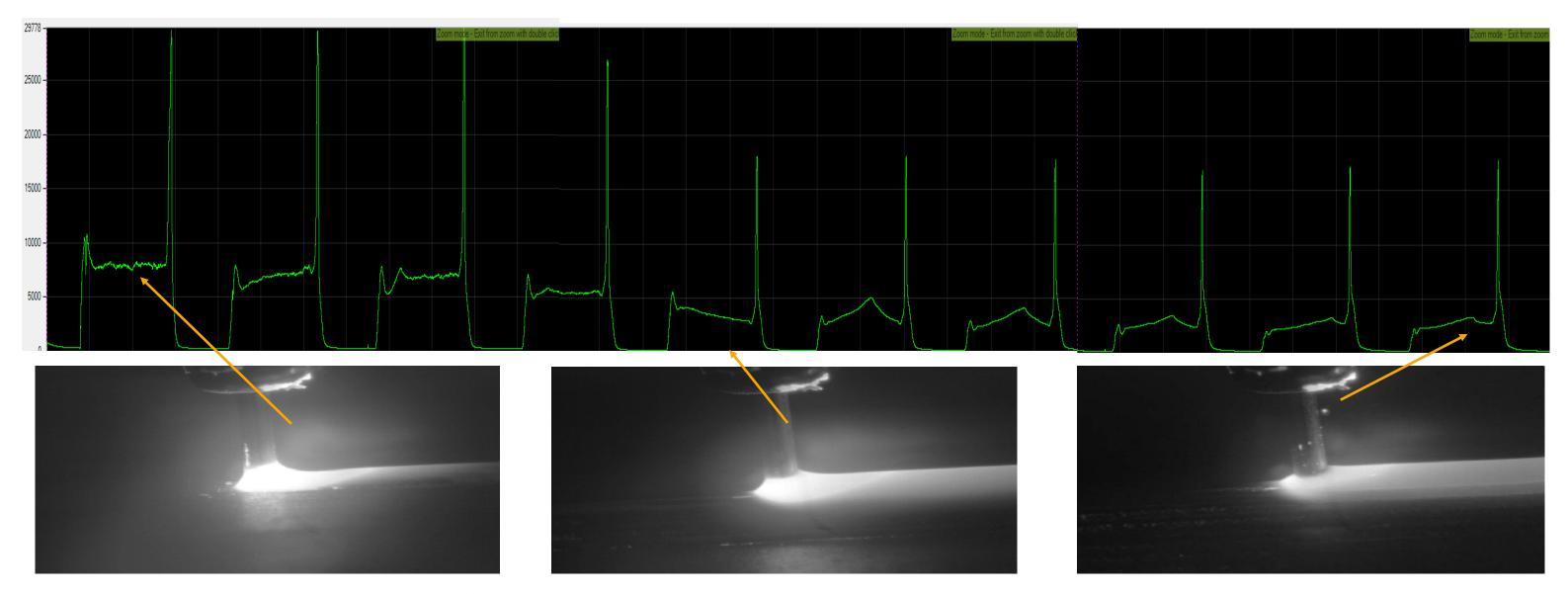# example diode based meltpool monitoring
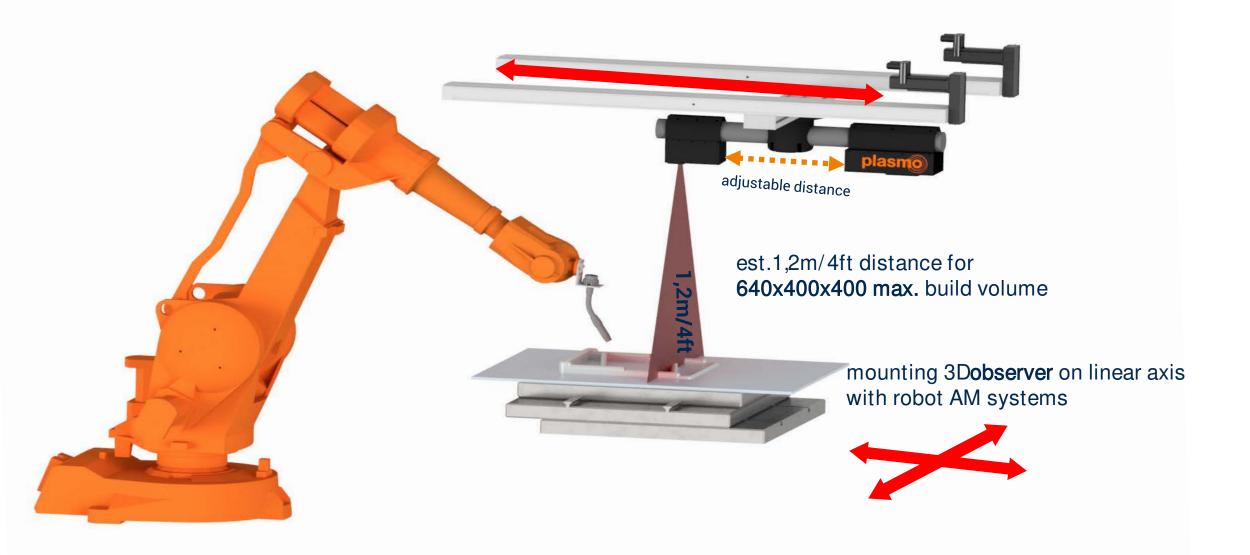## plasmo process**observer**

Complete part

1.5e+04

- o intensity decrease along building progress

- o change of meltpool size in one layer (detail on next page)

3Dobserver configuration

adjustable distance

1,2m/4ft

est.1,2m/4ft distance for
640x400x400 max. build volume

mounting 3D**observer** on linear axis
with robot AM systems

- AM feed stock mounted on Robot

- 3D**observer** mounted linear axis

- 3D**observer** scanning workspace

- Camera capture Laser projection
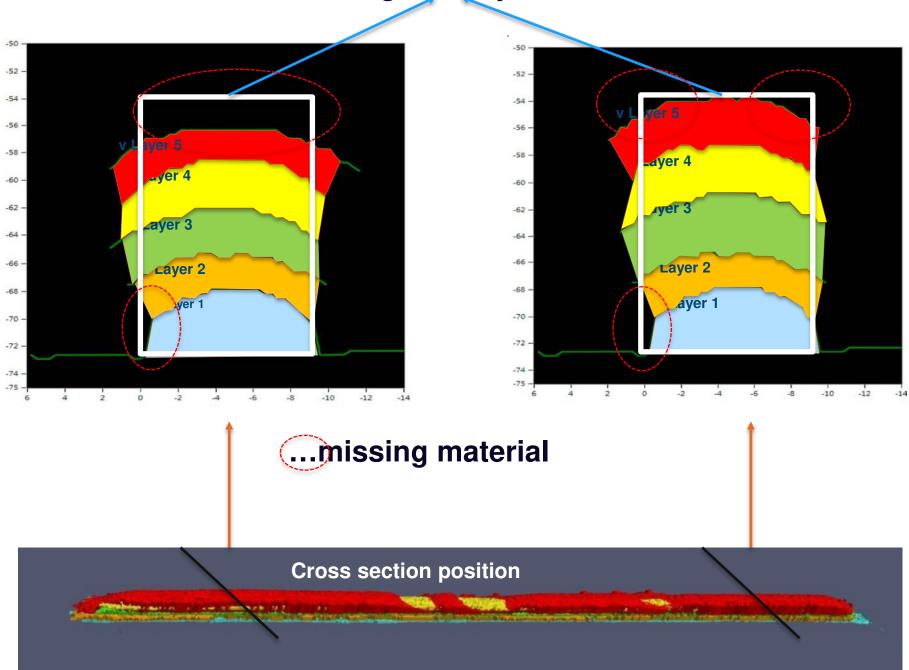
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example 3D measurement
plasmo 3Dobserver

3D ob...

▶

layer per layer and complete part

3Dobserver graphical measurement

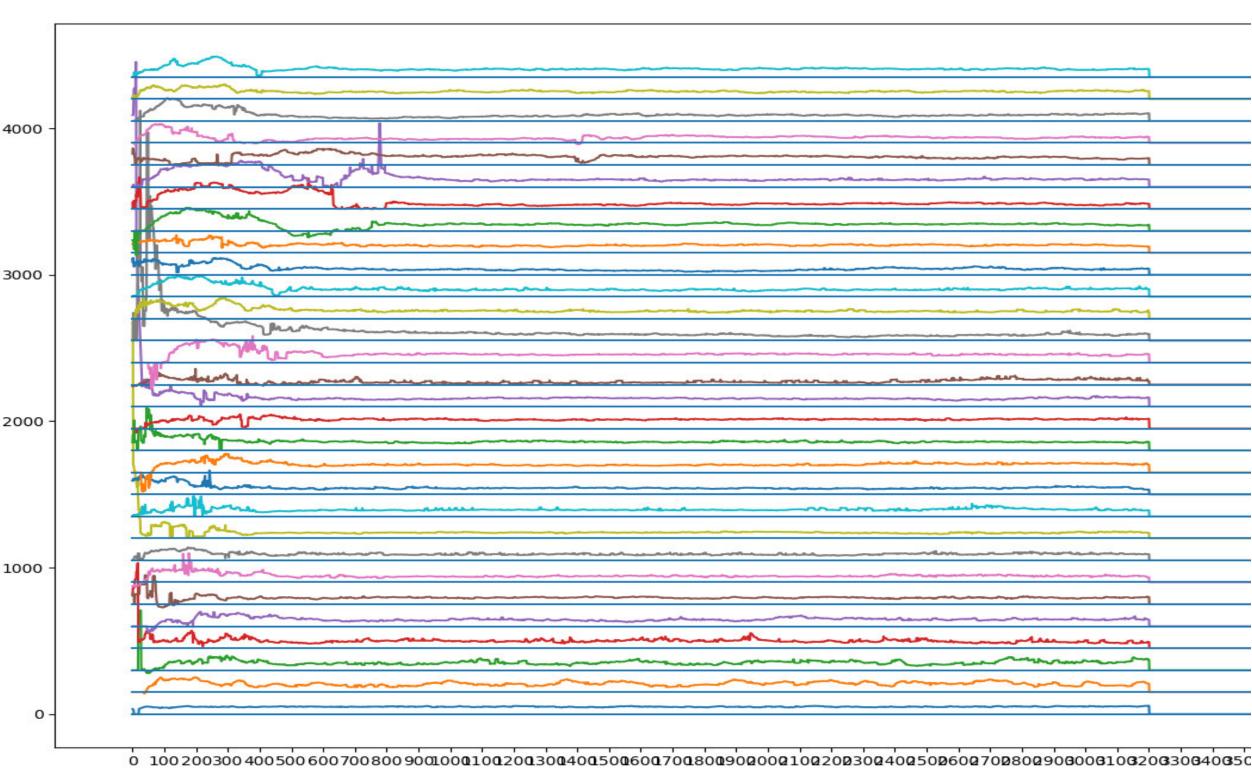**ideal geometry**

...missing material

Cross section position

- 3Dobserver data
  - Triangulation based
  - Height
  - Position
  - Volume
  - Absolute measurement layer per layer
  - Absolute measurement complete part
  - Cross section of all layers
  - Geometry of all layers in one picture
  - Compare the volume of the deposit material against volume of the wire used
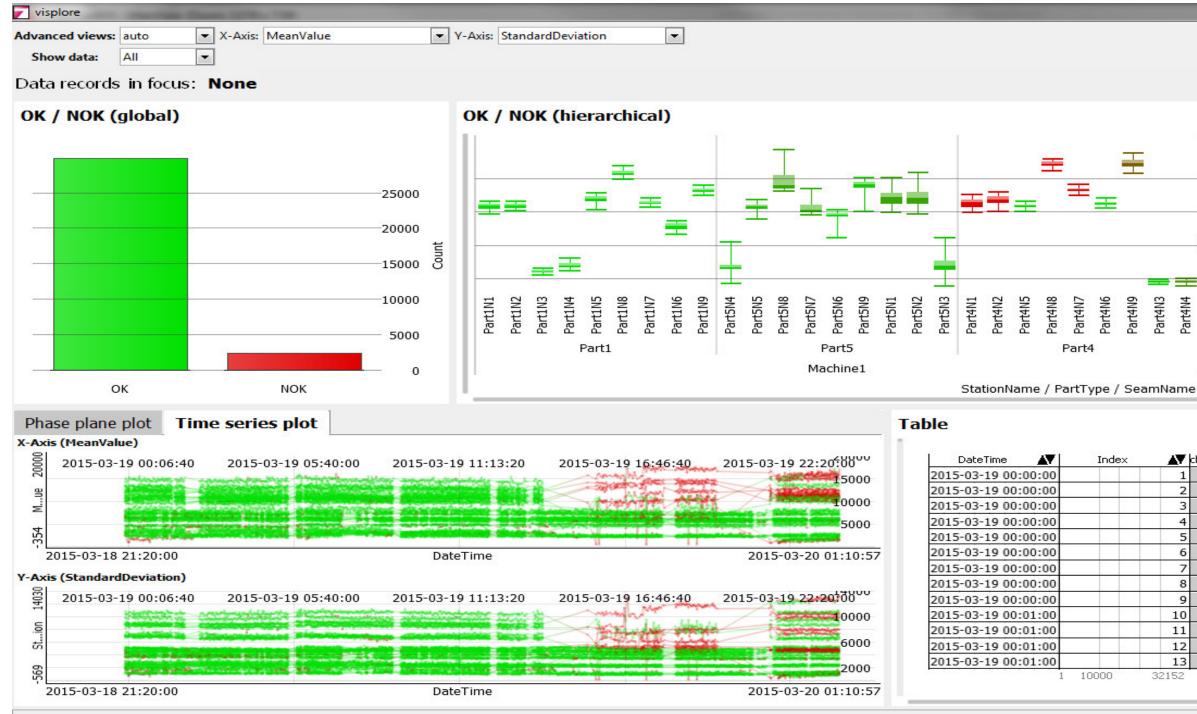
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3Dobserver Volume measurement

- 3Dobserver data
  - Volume
  - Instable at start
  - Volume changing per layer

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visualization, data analysis dashboards
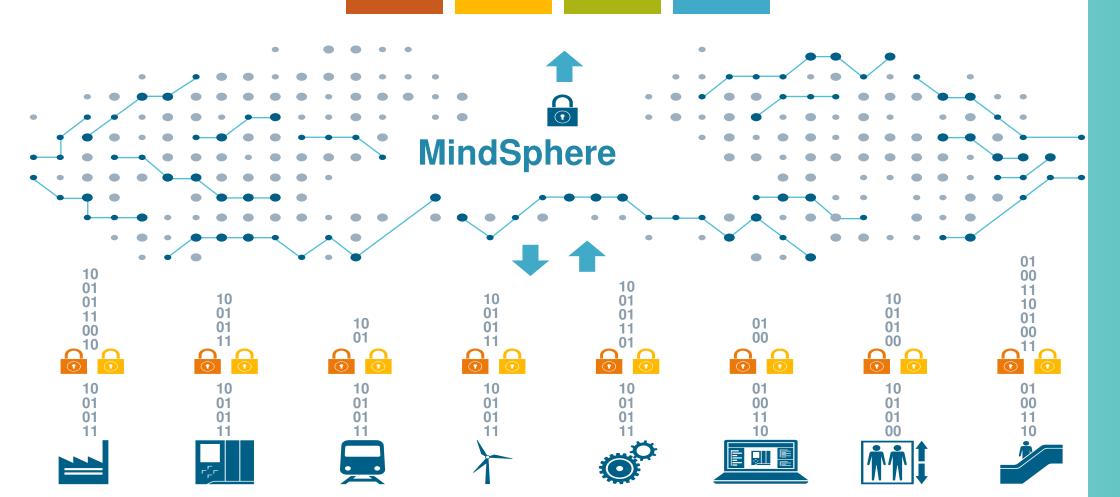
Siemens MindSphere Cloud with plasmo system in Operation

MindSphere
The cloud-based, open IoT operating system

SIEMENS
Ingenuity for life

MindSphere

plasmo

MindApps
Asset transparency and analytical insights into machines, plants, fleets and systems

MindSphere
Open Platform as a Service (PaaS)
for scalable, global IoT connectivity and application development with native cloud accessibility

MindConnect
Connecting products, plants, systems, machines, enterprise applications and legacy databases with secured plug and play connection of Siemens and third-party products and equipment

summary.

summary

o additive manufacturing is a key technology of the future

o quality inspection systems available on the market

o value for the customer has to be increased

- individual part dependent process parameters
- process optimization, statistic process control
- compare machines and processes worldwide
- root cause analysis
- standardization, certification

Pilotfabrik Seestadt
Demo system for DED Quality assurance

IGM Welding cell with Fronius CMT

- Real-time process monitoring
- Process visualization with plasmoeye
- Recording and analyzing of process parameters

TU Wien Industrie 4.0 Pilotfabrik
Stakeholder und Partner

Things
work out
the best
for those
who make
the best of
how things
work out.

John Wooden

Kontakt: Arnold Braunsteiner,
founder plasmo

Kontaktieren Sie uns!

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