

Multi-optional systems

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multi-optional systems
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1A TECHNOLOGIES
INDUSTRIAL 3D SOLUTIONS



**Does the additive (re)manufacturing of
spare parts make sense?**

multi-optional systems

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Overview

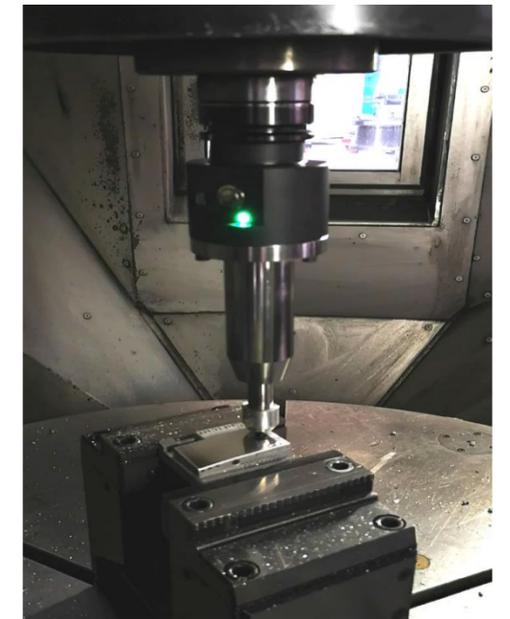
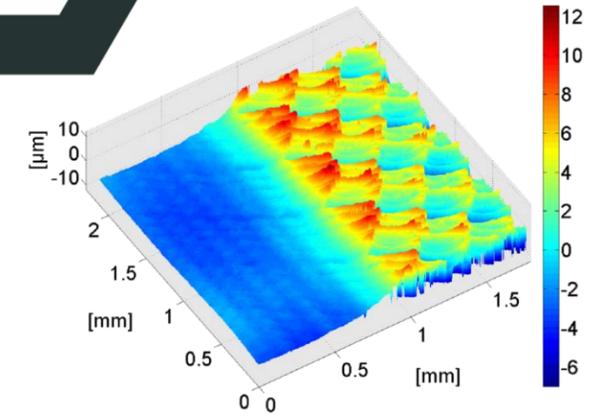
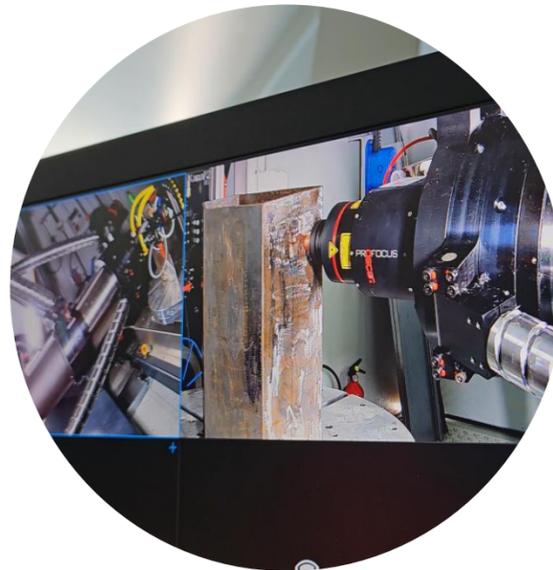
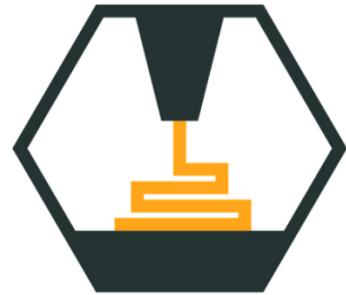
- Presentation of the methods used
- Examples of arc cladding
- Examples of laser cladding
- Examples of SEAM 3D printing (FGF)
- Outlook
- Summary



3D-printing



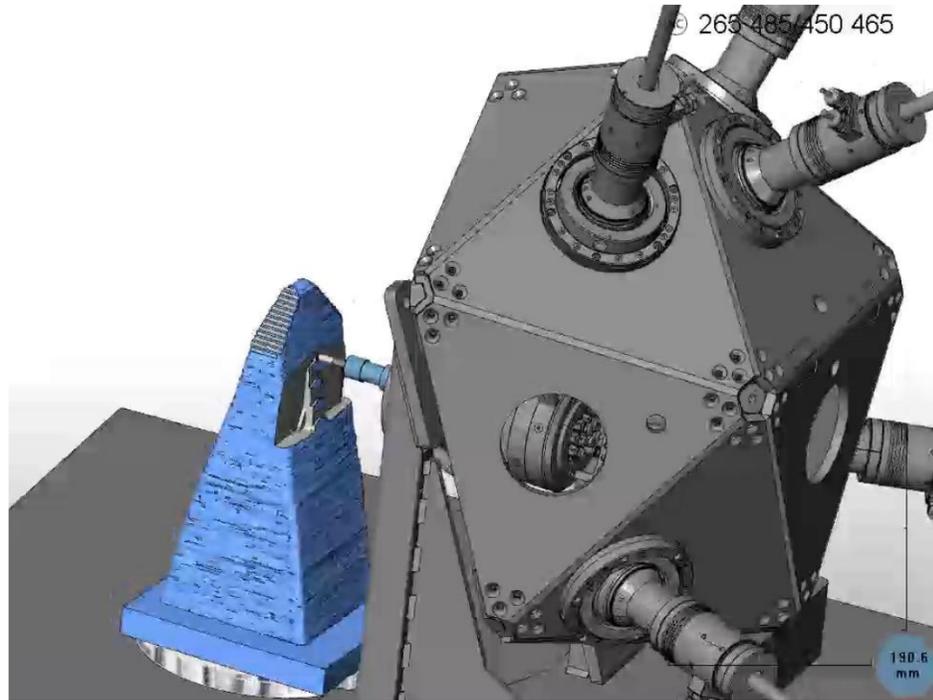
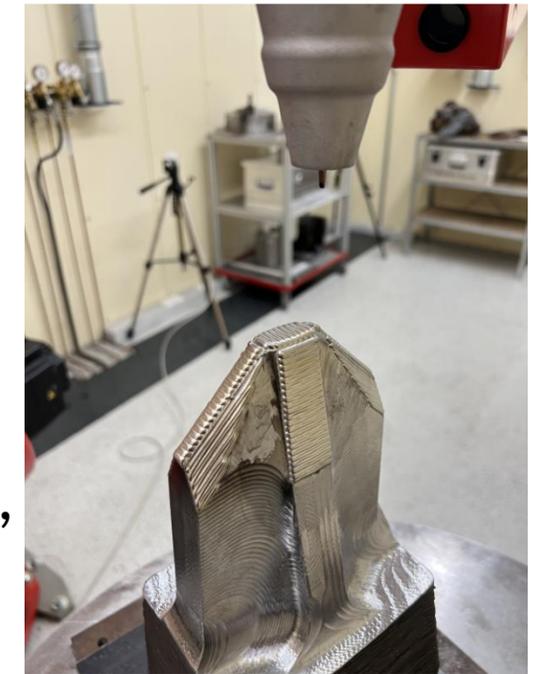
Postprocessing



Wire arc additive manufacturing excavator tooth as new part

- Manufacturing using WAAM
- Processing of the basic functional surfaces
- Additional wear protection by means of laser cladding
- Manufacturing time welding 14h, milling 2h, laser application 2h
- Pure manufacturing costs Welding allowance 10% → material 39€, shielding gas 33€, machine hours 238€ (18€/h) → 310€
- Cost of pure welded part already 3.8 times higher than casting from China

In cooperation with partner:

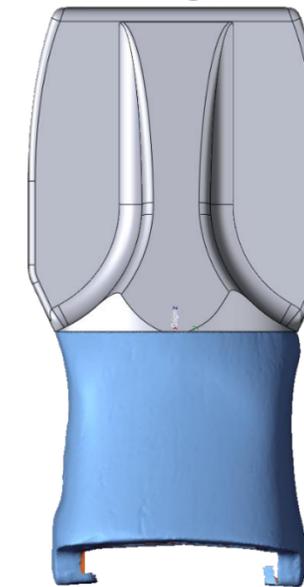
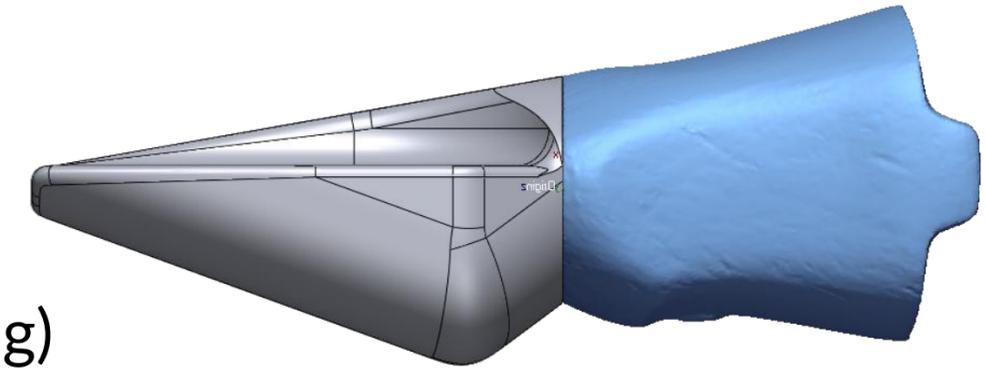


Excavator tooth 3D printing as a repair

In cooperation with partner:



- Mechanical processing at a defined height level using HSC machining
- Application without intermediate scan with hard application material
- No mechanical post-processing
- remanufacturing time 4 hours optimized (1 hour milling, 6 hours welding)
- Total costs 302€ without scan & without fixtures
- Below the cost of new parts
- Worthwhile for the appropriate component size and production technology availability



multi-optimal systems

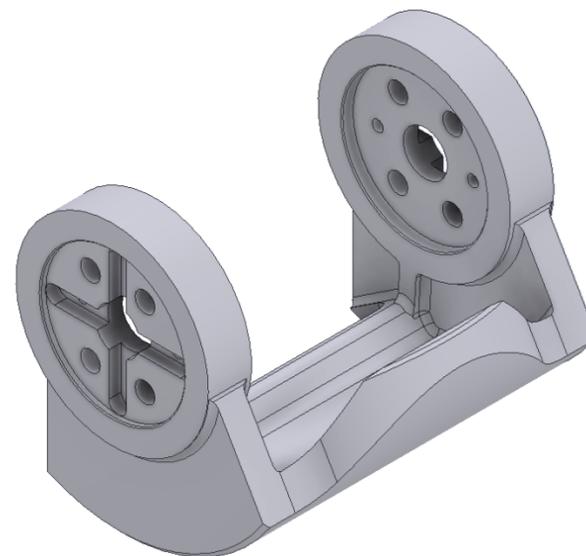
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New production as a replacement for cast components



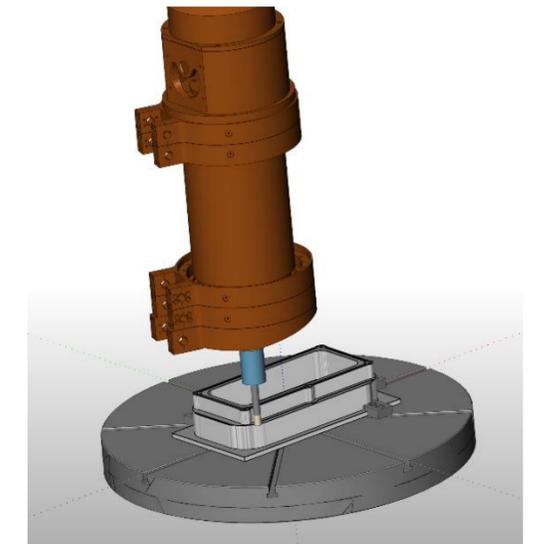
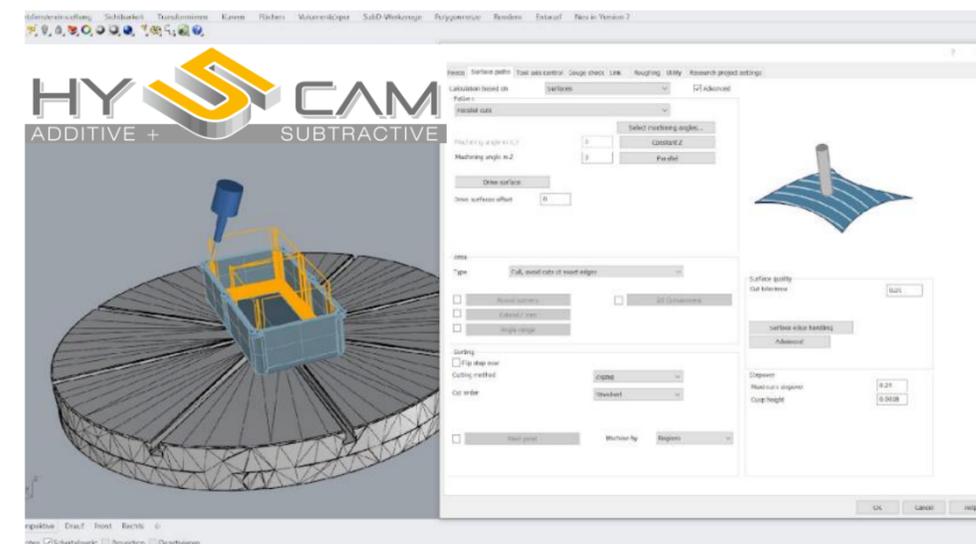
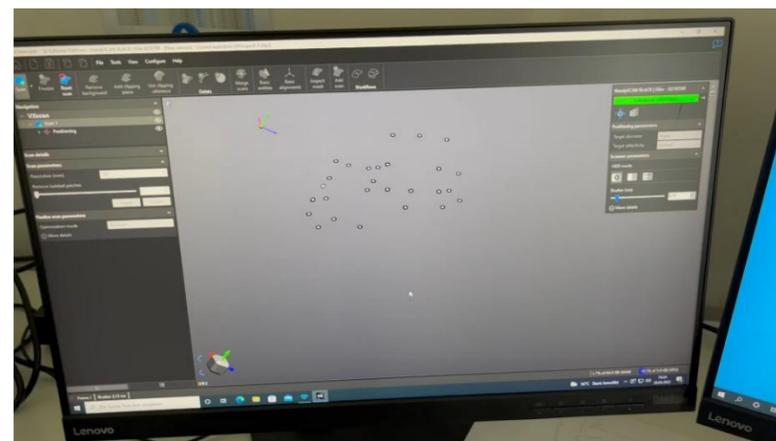
- Production of a throttle gate valve using WAAM (75kg with net weight 28kg) with Voestalpine Thermanite
- Intermediate processing of inaccessible areas
- Production of reference points for final machining
- Manufacturing time welding+milling 2 weeks vs. 6 months delivery
- Due to single piece, cost advantage of approx. 40%
- Quality assurance of individual layers and correction instead of finished part without the possibility of repair



Use Case for Spare Parts Production

Source: Bernhard Schulte Shipmanagement

- Corroded windshield wiper housing on the offshore supply ship Leibniz
- Safe continuation not guaranteed, spare part not available in stock
- 3D model not available
- Reverse engineering with a Creaform scanner
- Visualization and Collision Detection for Additive and Subtractive Manufacturing to Test the Usable Equipment



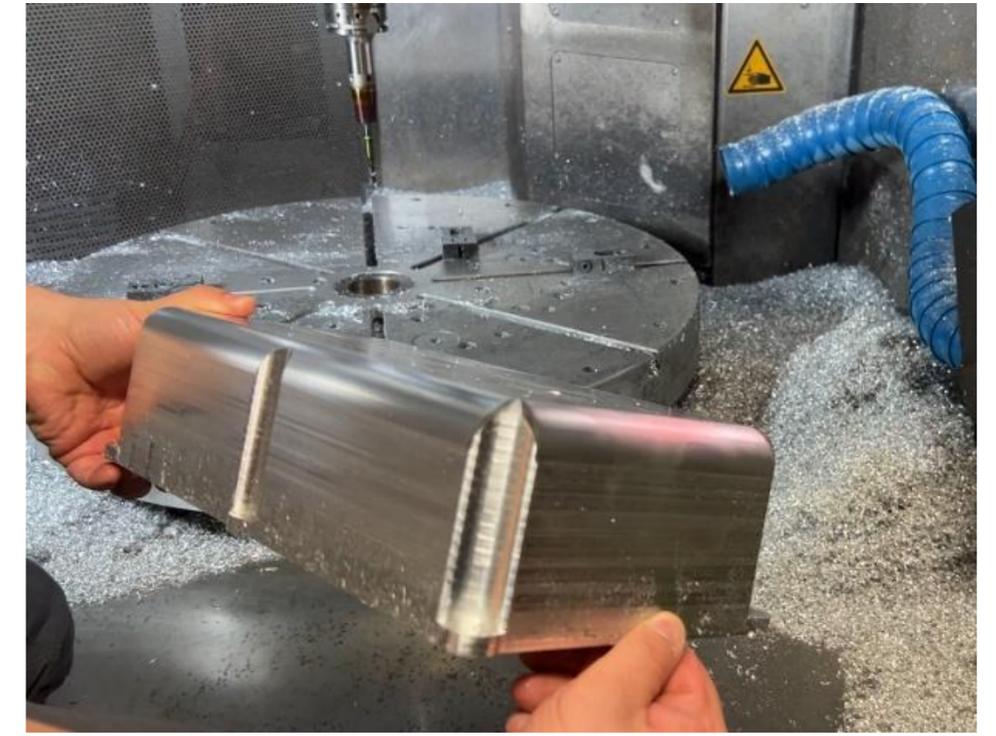
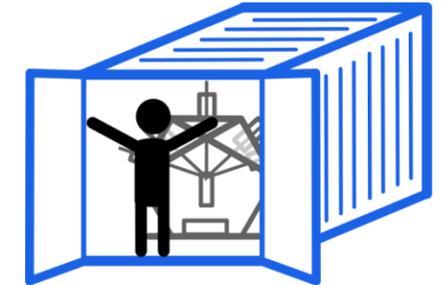
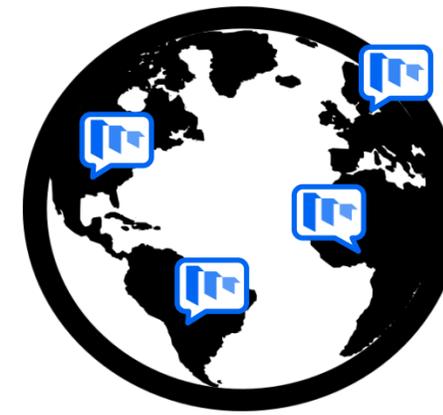
Manufacturing in the Mobile Smart Factory

Mobile

Smart

Factory (in a box)

- 3D printing with WAAM
- Machining in 2 machining positions to reach all areas
- Total processing time 2 days including programming, welding and machining
- workpiece can be used directly because it is made of seawater-resistant aluminum

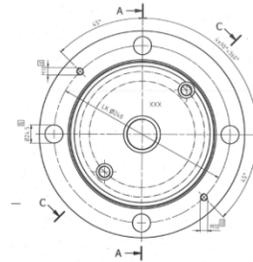


Manufacturing under the aspect of "Battle Damage Repair"

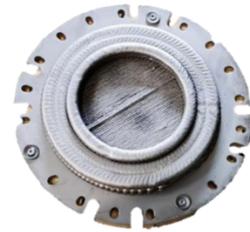


Manufacturing process from 07:00 am.:

1 Drawing to CAD-CAM
>09:00am



2 Printed part
>11:30am



3 Finished part
>3:00pm



Hybrid remanufacturing in One Machine

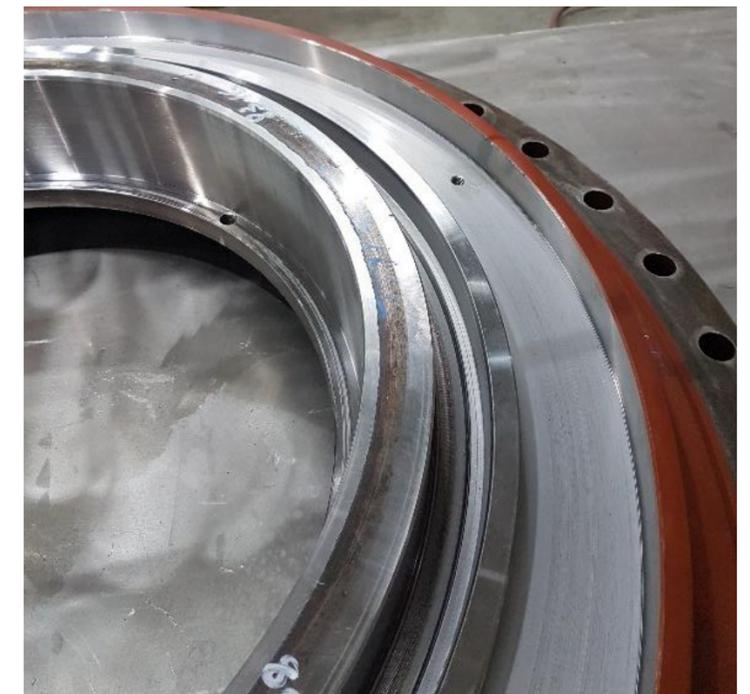
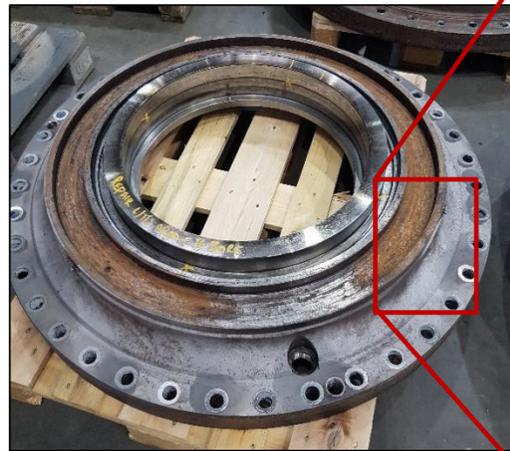
Pre-processing



Cladding



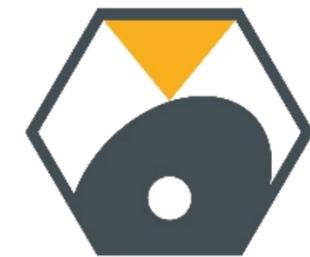
Finishing



Mill-turning



Laser-DED



Turning

Performance data

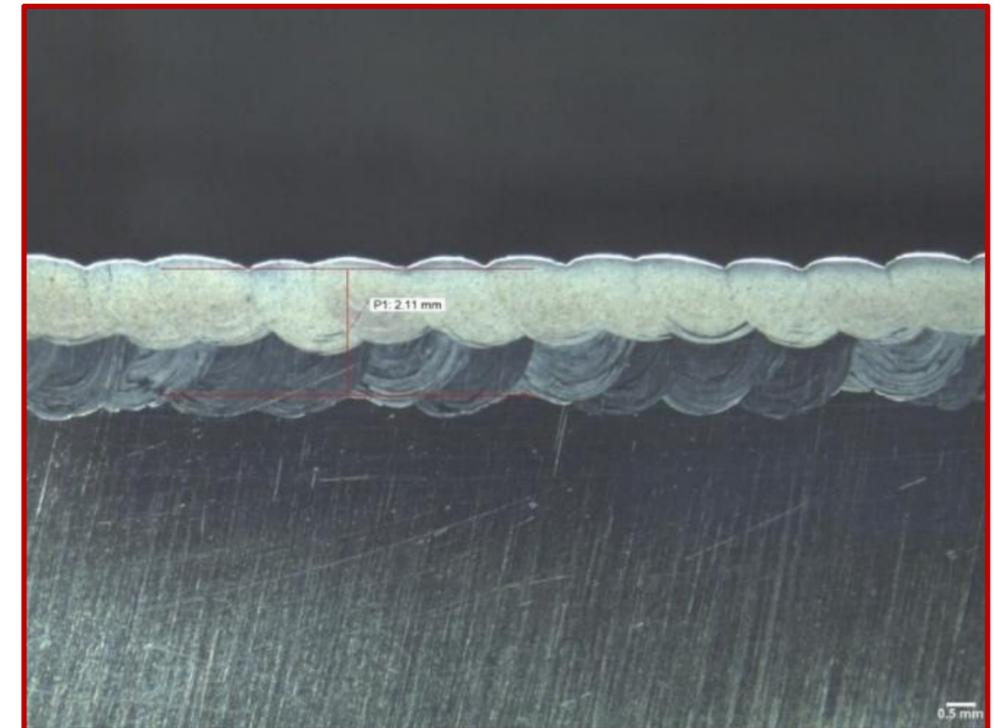
Machining

Cutting width 30mm
Cutting depth 0.5mm
Feed rate 6000 mm/s
Tool HSKA63
Material 42CrMo4
Removal rate 5,400 cm³/h -> 42.3 kg/h



Welding

Laser power 2 kW
Wire feeder 4.0 m/min
Feed rate 30 mm/s
Wire d=1.0 mm
Material 42CrMo4
Application rate 1.5 kg/h



Advantages of hybrid remanufacturing using laser welding + milling

- Automatic repair after clamping the part on the table, the process can be stopped every time for a shift change or measurement
- No intermediate scanning or best fit measurement of the component necessary
- Low energy consumption (~8kW dry milling, ~9kW welding)
- No preheating required for GGG60 or 42CrMo4V
- Wire cladding - > no powder contamination
- 5€/kg wire cost
- 0,20€/kg cost of cutting tools
- Large portfolio of components can be remanufactured

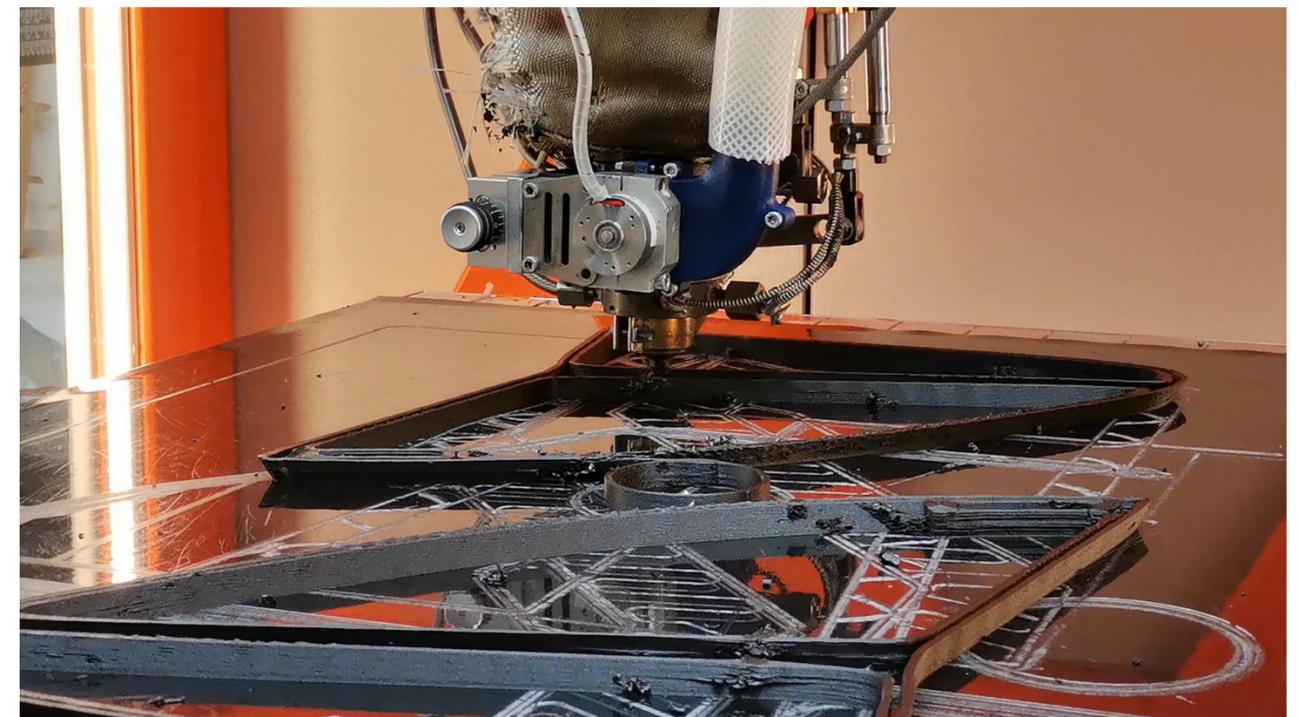
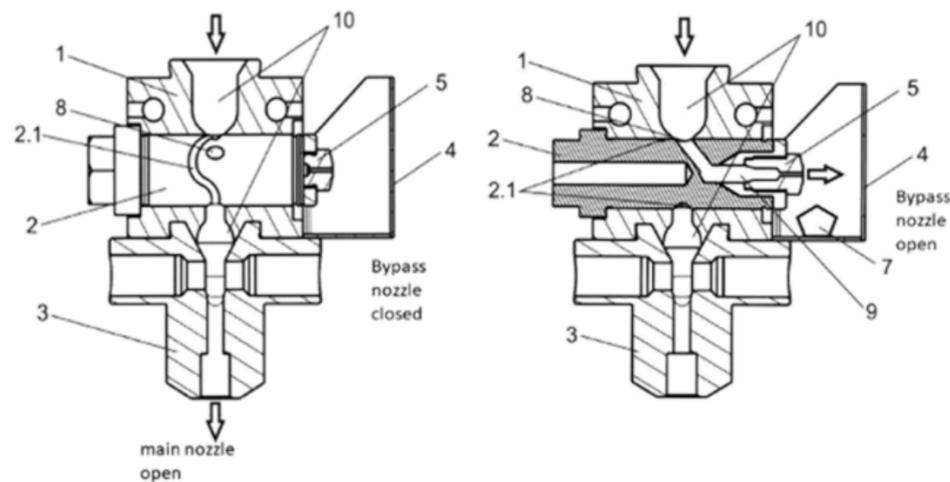
In cooperation with partners:

OSCAR
JUST ADD METAL.



Screw Extrusion Additive Manufacturing - SEAM

- Plastic 3D printing using a single-screw extruder (FGF)
- Patented bypass nozzle system for automated volume flow control
- Constant component quality - compensation of process fluctuations
- Discharge capacity up to 18kg/h, printing speed up to 1000mm/s

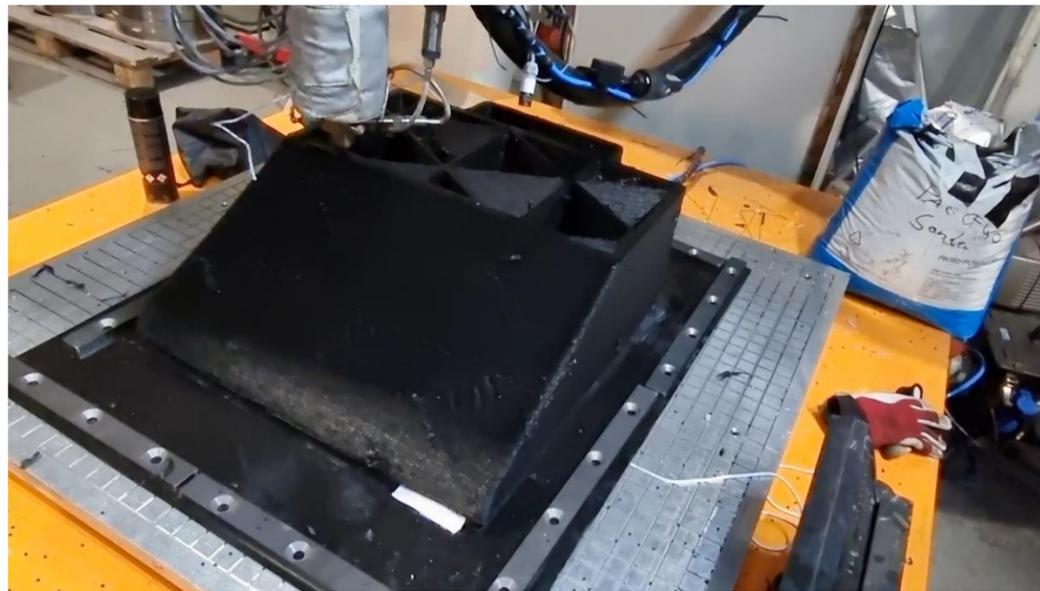
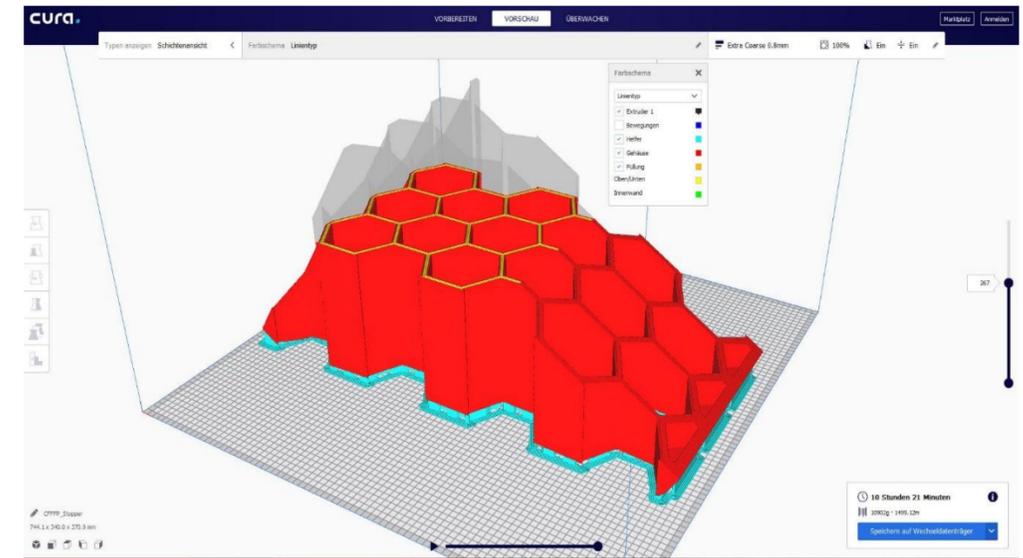
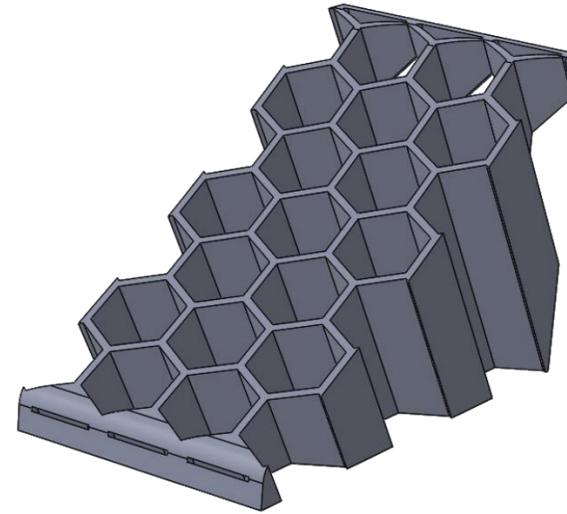


Exclusive license partner of Fraunhofer IWU:



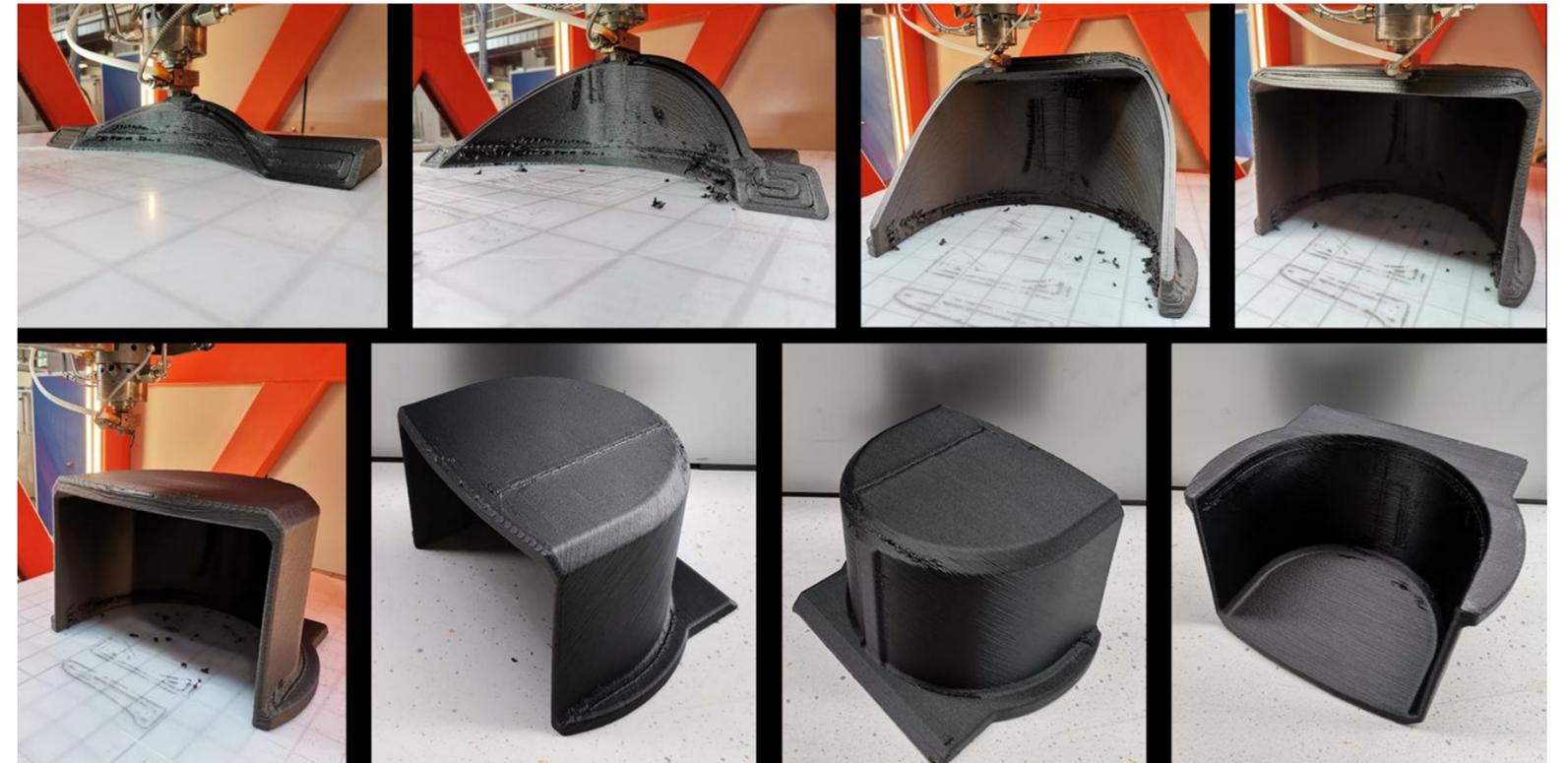
SEAM truck stopper for mining trucks

- Substitution of a steel component
- First concept printing time 10.5 hours
- Second concept printing time 4 hours
- Material costs 120€ for both variants
- Lightweight and stable
- Adaptable to occupational safety requirements and regional needs (lifting weight, size)



SEAM Screw Extrusion Additive Manufacturing for spare parts

- 45° slicing for load-appropriate load distribution of the layers
- Possibility of horizontal overhangs without support structure
- Lubricating grease cap for excavator swing gearbox
- Original casting ~ 40kg
- 3D printed: 7 kg
- Printing time 4 hours
- Material costs 56€
- Cost ~500€/part



In cooperation with partners:

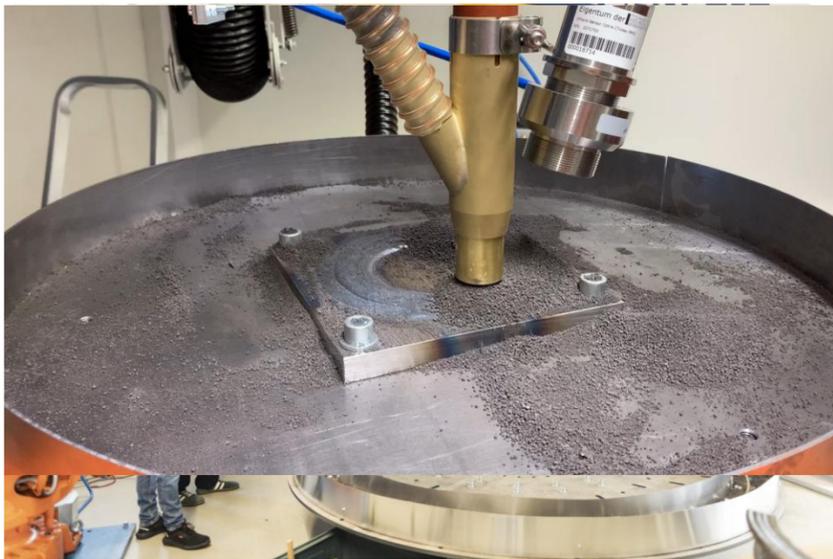


source: Fraunhofer IWU

Outlook on current exciting developments from our partners for order rates >5kg/hour suitable for the (re)production of large components

Submerged Arc Additive Manufacturing

[Technologie Campus Parsberg - Lupburg]



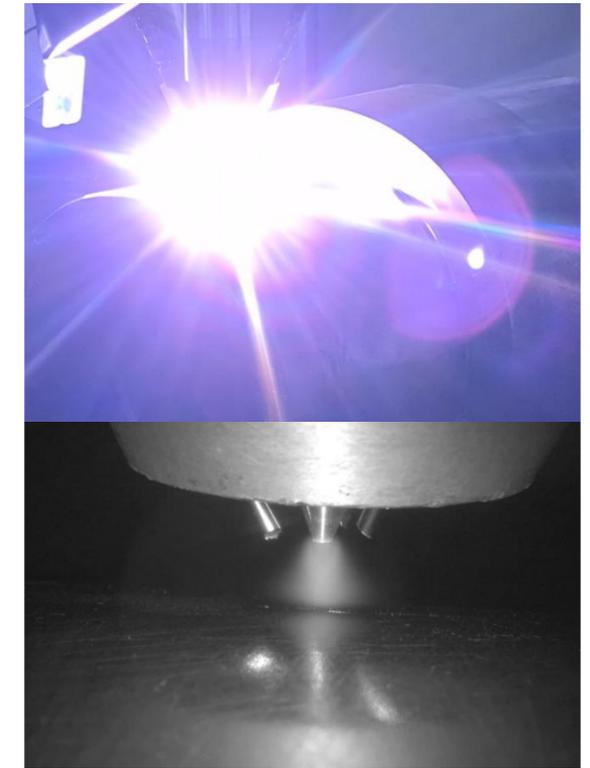
Material: Steel, Inconel
 Advantages: simple, cheap, overhangs 3ax
 Limits: Cooling times

Makro Selective Laser Melting:



Material: Steel, Inconel, Alu
 Advantages: omnidirectional, 3ax overhangs
 Limits: Laser protection

GTA-^{3D}-welding OSCAR JUST ADD METAL.

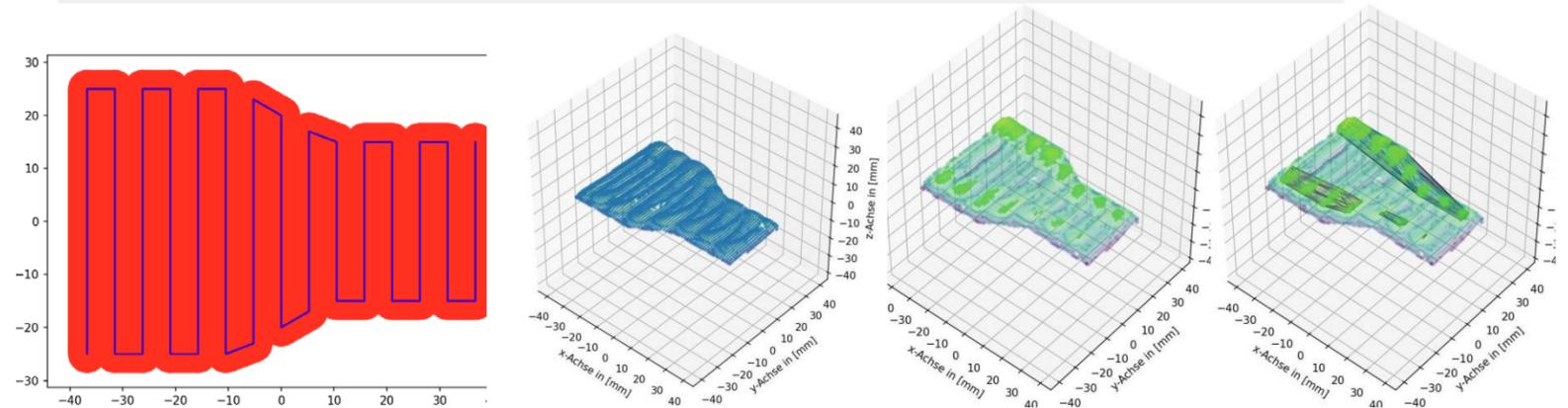
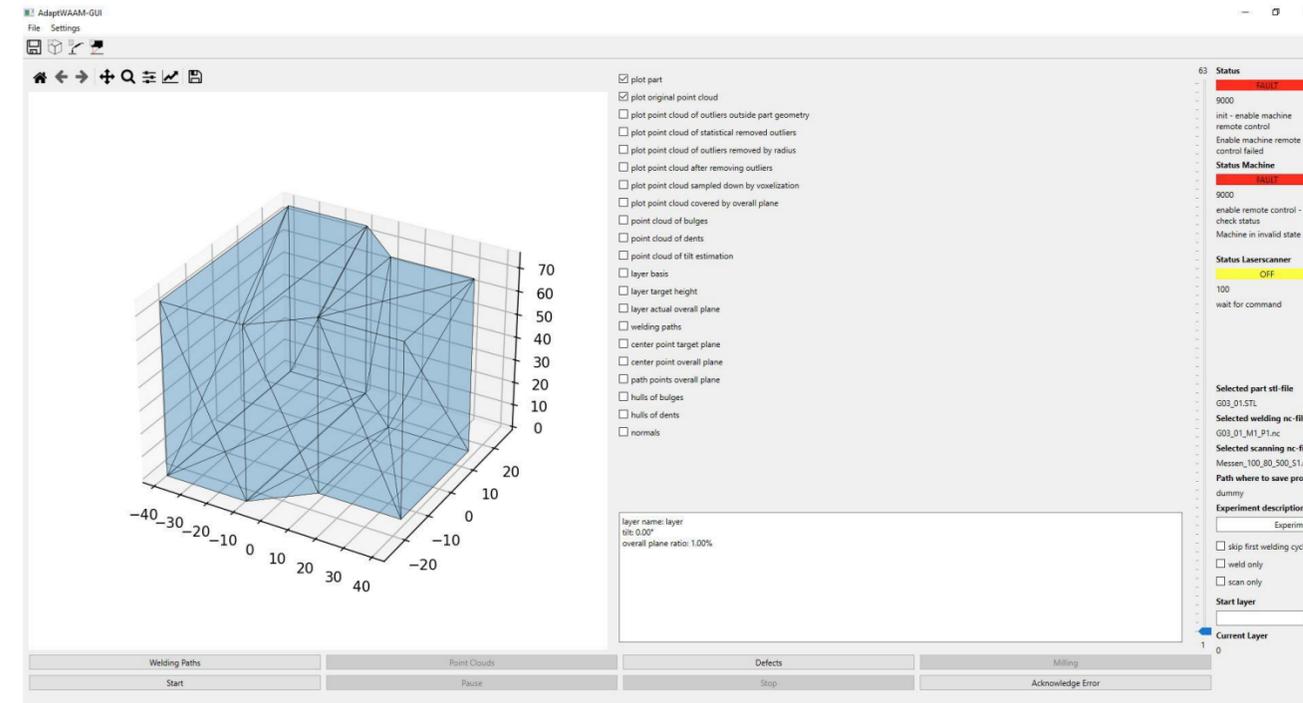


Material: Bronze, Steel, Inconel
 Advantages: omnidirectional, no powder handling
 Limits: Overhangs

Outlook on Automation

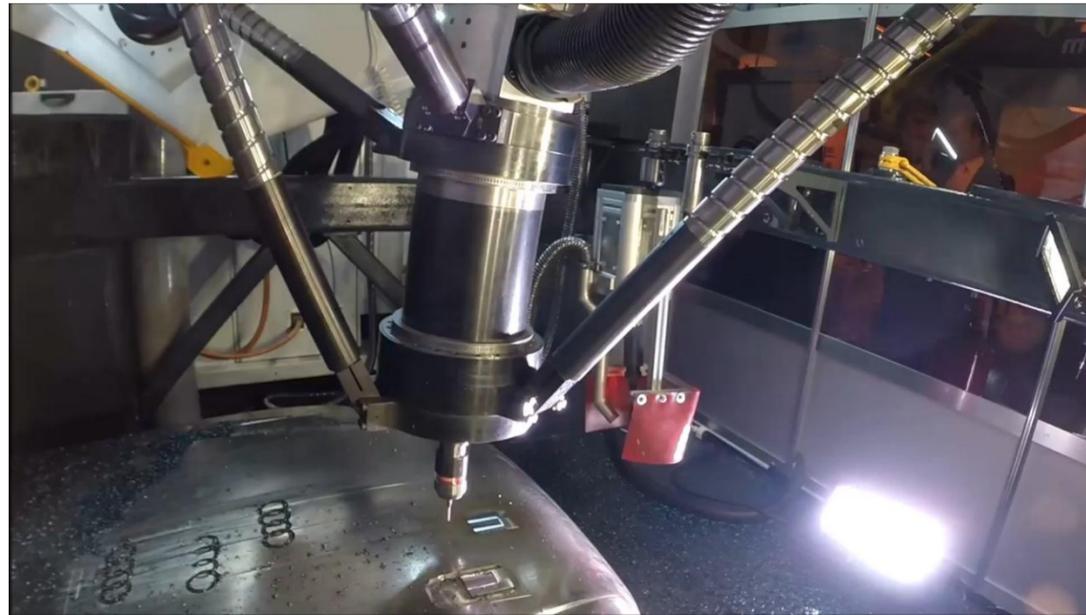
- Adaptive 3D printing with automated correction
- Without operator influence
- 100% quality monitoring

In cooperation with partners:

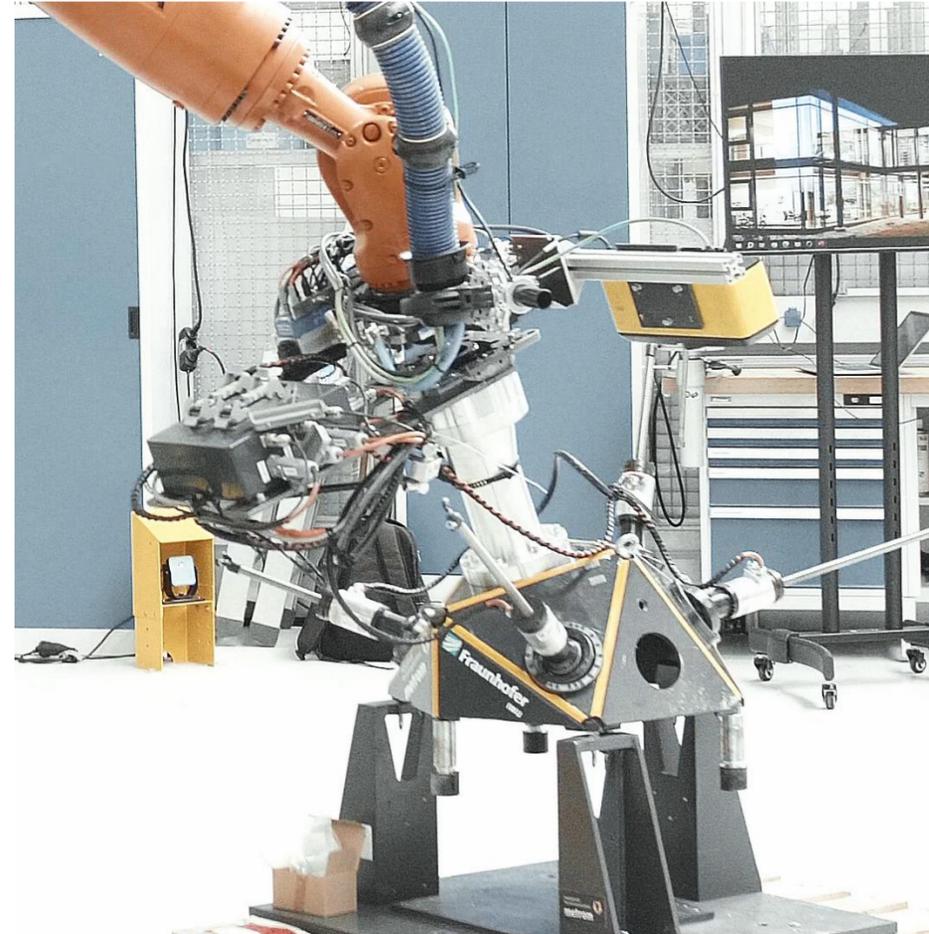


Outlook 3D printing + post-processing for large components

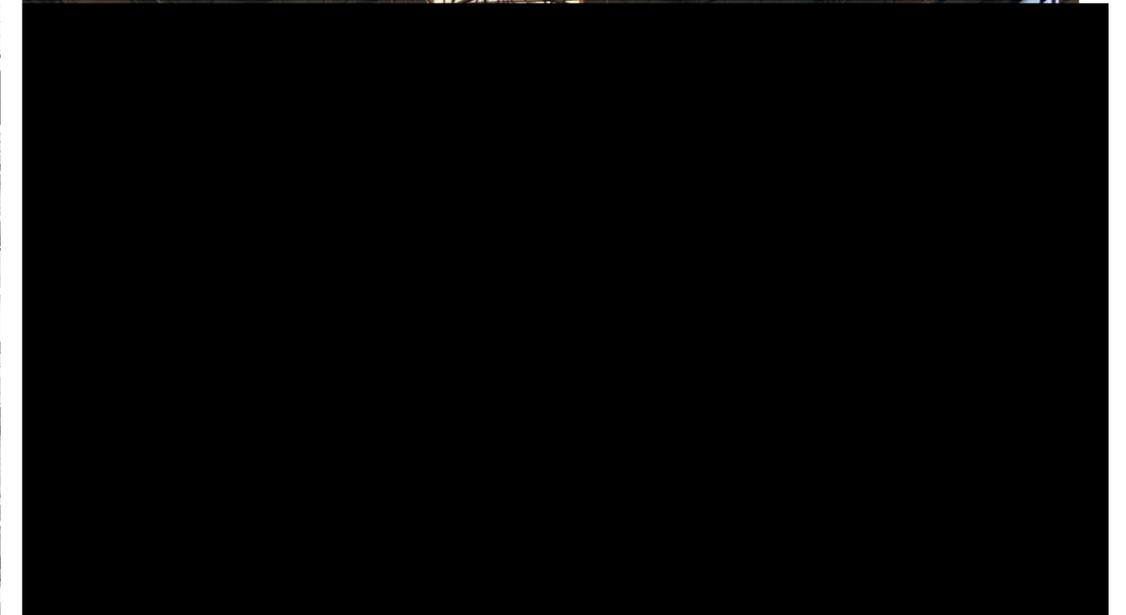
Mobile hybrid
Machine



Mobile machine
+ Robot



Mobile machine +
Driving system



Does additive (re)manufacturing of spare parts make sense?



- How soon do I need a replacement?
- What alternatives do I have – repair, reproduction, replacement products...
- What approval requirements and properties does the component have to meet?
- What are the consequences of a lack of spare parts supply?

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