CECIMO WEBINAR
Additive Manufacturing: An opportunity to fill the gaps in traditional supply chains

Thursday 2nd of July, 11.00 am - 12.10 pm
Embedding AM into industrial value chains

Dr. Bernhard Mueller
Fraunhofer Additive Manufacturing Alliance
Additive Manufacturing at Fraunhofer: One topic – twenty institutes – one alliance

- **Engineering**
  to invent and design new products and develop suitable process chains
- **Materials**
  to adapt new materials
- **Technologies**
  to achieve (cost-)efficient processes
- **Quality**
  to control and ensure manufacturing reproducibility and product quality
- **Software and simulation**
  to develop intelligent algorithms apply simulation efficiently

Contact: Dr. Bernhard Mueller
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Fraunhofer vs. Corona: Providing 3D printed face shields to first responders

- Johanniter Unfall-Hilfe (German St. John’s Order) asked for 5,000 face shields for training purposes
- AM network Medical goes Additive (MGA) supported Johanniter’s call for help within its initiative “3D Printing fights Corona”
- Fraunhofer AM Alliance manufactured and donated 550+ of the 5,000 face shields
- 6 Alliance member institutes involved: EMI, IAPT, IGCV, IPA, IPT, IWU
- FFF and SLS technologies used to 3D print the face shields

»This work was supported by the Fraunhofer Internal Programs under Grant No. Anti-Corona 072-600101«
Sources: Fraunhofer IML, Ruhrlandklinik Essen

Fraunhofer vs. Corona: Providing 3D printed face shields to first responders

- Fraunhofer IML re-engineered open source file for face shields to optimize it for polymer laser sintering
- Production increase from 60 to 500 face shield components in one print job
- Production of clear visors with laser
- Fraunhofer IML manufactured (in cooperation with FH Dortmund) 1500 face shields for local hospitals and doctors

Contact: Mathias Rotgeri
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Lighthouse Project Future AM: Project overview

Digitization of additive manufacturing along the entire process chain

Extensive automation of post processing

Increase of build rate and component size and in-process monitoring

Increase of material diversity and multi-material processing
Lighthouse Project Future AM: Project Challenges in post processing

Process chain of additive manufacturing of metal components

- Post processing causes up to 70% of the overall component costs

- High percentage of manual work
  - for component removal
  - for removal of support structures
  - for mechanical post processing

- Missing integration in industrial manufacturing environments and process chains
Lighthouse Project Future AM: Automated post processing

Aim

- Reduction of personnel costs by 50%
- Reduction of production time by 50%
- Reduction of post processing costs by 70%

Modular autonomous manufacturing cell with technology modules for

- Powder removal
- Handling with robotics
- Component identification
- Cutting
- Optical dimensional measurement
- Mechanical post processing

Process chain

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Lighthouse Project Future AM: Component identification

Motivation
- Disbanding rigid process chains requires clear allocation between component and production parameters
- Traceability in different industry sectors required or mandatory
- Clear identification protects from product piracy

Solution approach
- Use of manufacturing possibilities to integrate a codification inside the component

Process Planning and codification
Reading of the code by different non-destructive measurement methods
Signal evaluation, decoding, data assignment
Lighthouse Project Future AM: Chosen identifiers and non-destructive readout methods

1D Barcode, Pharmacode [456]

2D UDI Barcode, Datamatrix [658942]

- Eddy current (EC)
- Ultrasound (US)
- X-ray (Micro CT)

Demonstrator Hip stem long

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Fraunhofer vs. Corona: MobiMed – Development of a mobile production line for medical equipment and facilities in crisis regions

Data management
- Easy to use ordering system
- Order catalogue for common medical products
- Provision of variants

On-site production
- Process chain for plastic components
- User support by Augmented Reality (AR)
- 20ft container format for maximum versatility

Quality assurance
- Part traceability by QR-codes
- AR-supported part check
- Sterilization and packaging

Supply chain for medical equipment with high criticality

»This work was supported by the Fraunhofer Internal Programs under Grant No. Anti-Corona 179-640001«

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IDEA – Industrialization of Digital Engineering and Additive Manufacturing

**Digital Engineering**
- Design & Modelling
- Process Parameters
- L-PBF Process
- De-Powdering
- Heat Treatment
- Baseplate Separation
- Conventional Machining
- Surface Finishing
- Quality Control

**Industrialization**

**Description**
- In the additive process chain, individual process steps are currently mostly isolated and associated with a large number of manual operations.
- In the project, the basics of industrialization (data preparation, machine setup, etc.) are developed for all process steps, so that individual process steps can be integrated in one production line.

**Focus of Fraunhofer IPT**
- Concept for automated component handling
- Software tool for CAM planning for removing support structures
- Software for process chain evaluation depending on the component design

**Target**
- Realization of a fully integrated, automated production line

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12

Support Code: 13N15001
IDEA – Focus of Fraunhofer IPT

Automation
- Automation concepts for component handling
  - Analysis of the existing processes and hardware
  - Development of a holistic methodology
  - Generation and simulation of automation concepts

Support structure removal
- Software for removal of support structures
  - Simulation of contact conditions
  - Execution of physical milling investigations
  - Development of material removal simulation

Process chain evaluation
- Software for automated process chain evaluation
  - Formal description of technologies and parameters
  - Development of framework for data acquisition
  - Development and implementation of decision logic

Source: Fraunhofer IPT
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POLYLINE – Integrated line application of polymer-based AM technologies

Description

- Vertical and horizontal integration of AM processes in conventional lines can only be implemented to a limited extent due to the lack of standards across process chains.
- Reason: AM-specific production steps ("batch process") and low level of automation of the physical handling and transport processes.
- Digital data chain is not continuous, which currently leads to intransparency, error-proneness and limited monitoring.

Target

- Equivalent to the IDEA project with its focus on metal-based AM, the POLYLINE project focuses on the automation and integration of laser sintering of polymers along the entire process chain.

Source: Fraunhofer IML
POLYLINE – Focus of Fraunhofer IML and IGCV

Integration:
- Development of an integration concept:
  - Integration of all process steps into an optimized AM process
  - Integration of the AM process into conventional production environments

Material flow:
- Flexible linking of process steps is a prerequisite for successful automation of an AM-line
- The entire material flow is considered
  - transport of exchangeable frames, components and powder
- Implementation of concepts in cooperation with consortium partners

Digital process chain:
- Focus on digital process chain in additive order processing
- Concept for optimal production planning and control of the POLYLINE is being developed
- Concept will be tested for scalability in a simulation

Quality and technical cleanliness:
- Analysis and optimization of the areas of component cleaning and finishing
- IGCV develops cleaning process chains to close process-related gaps
- Target is to increase resource efficiency and product quality

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POLYLINE
Integrated production line of polymer-based AM applications
Thank you for your attention!

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