Neotech AMT

Advanced Manufacturing Technologies for 3D Printed Electronics

Scalable 3D Printed Electronics - "Fully Additive" to High Volume Manufacture

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Agenda

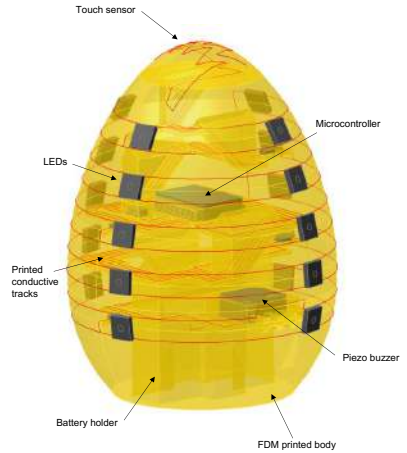
1. Company Overview

2. What is 3D Printed Electronics?

3. Scalability & Application Examples

Neotech AMT GmbH

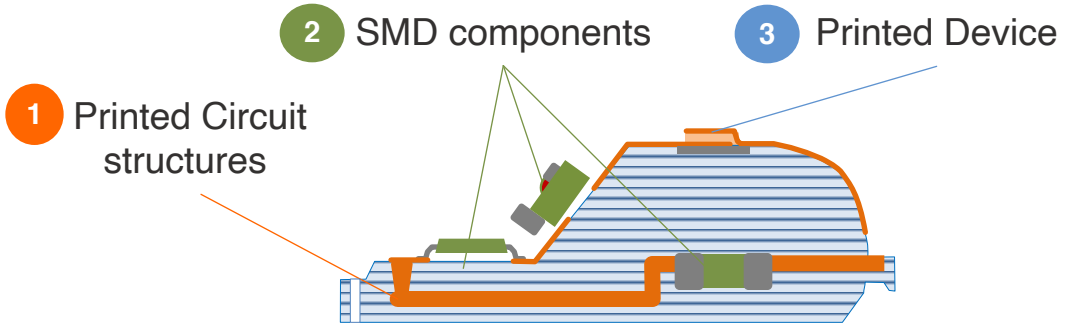
- Neotech manufactures system for 3D Printed Electronics.
- Pioneering 3D PE development since 2009.
- First 3D capable system installed in 2010.
- Patented mass-production capable system of type 45X built 2012.
- 1st commercial sale & install of mass production system in Q3 2013.
- 1st commercial mass production started on Neotech systems in Q3 2015.
- Winner of the 2019 TüV Süd – Innovation prize with FAPS (University Erlangen-Nuremberg)



"Fully Additve Electronics"
(FAPS-Neotech)

What is 3D Printed Electronics?

3D PE is the addition of printed electronics functionality, sometimes in combination with classical SMDs onto and/or into structural components to create mechatronic systems

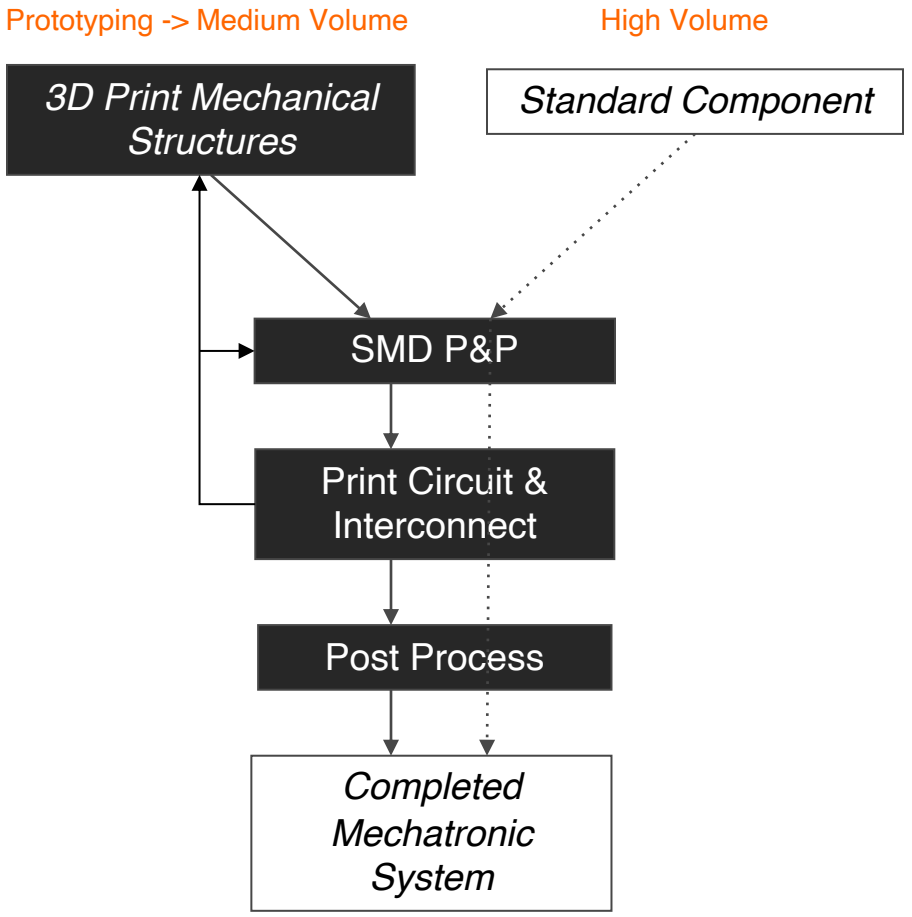


Scalable Process Chains

Two basic process chains exist for 3D Printed Electronics:

1. For high volume manufacture, electonics are intergrated onto the surface of a standard components (mouldings, composites etc.)

2. For lower volumes “Fully Additive” manufacture can be applied – classical structural AM (via FFF, SLA…) is combined in the 3D PE process.



Benefits of 3D Printed Electronics

Design Flexibility	Economics	Environmental
Integration of Mechanics-Electronics-Optics	Reduced Part Count	Reduced Materials Mix
Flexibility of Shape	Shorter Process Chains	Simplified Recycling & Disposal
Minaturisation	Reduced Materials Use	Reduced Material Quantity
New Functionality	Increased Reliability	Reduced Parts Tourism

Multi-station Printing
at LITE-ON Mobile Mechanical SBG

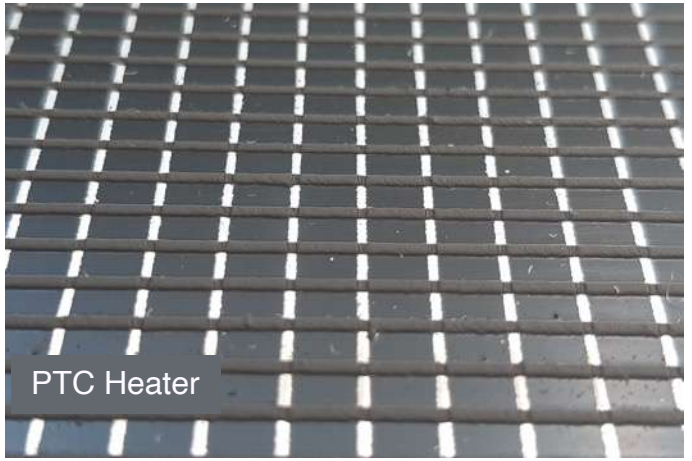
Tank Filling Sensor
Automotive

Current Applications

(Printing on exisiting 3D structres)

Automotive Applications in Development

Functionality	Current	Planned (2021-)
Heater Patterns	Lidar/Radar	
	Rear windscreen	
	Cabin Interior (PTC)	
Lighting	Cabin Interior (LEDs) with touch sensor control	3D OLED
	Optical Waveguides	
Sensing	Temperature sensor	
	Pressure sensor	
Sustainability	Weight Reduction for Cabin Interior	Frame/Body panel
	Automated Recycling	Electronics on Sustainable Substrates


PTC Heater

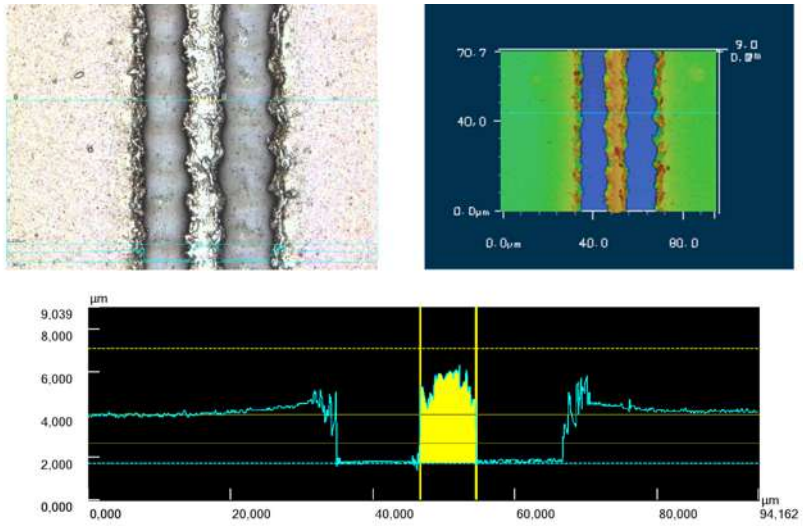
Mobile Communications – Antenna & Circuits

Ag inks & pastes on moulded thermoplastics: PA, PC, PC/ABS…

Particle free inks in test and show some promise

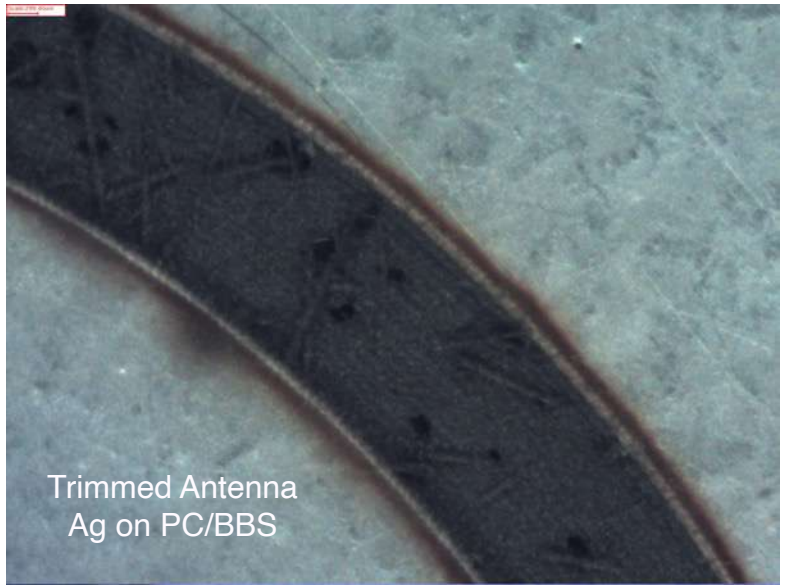
RF Performance: matches industry standard
Production Costs: specific antenna designs show cost benefit

Current development: rapid print and laser trim
Further cost reduction and improved performance
New route also enables rapid processing of fine line features down to 10um



Fine Line (9 ± 1 µm)/High Aspect Ratio

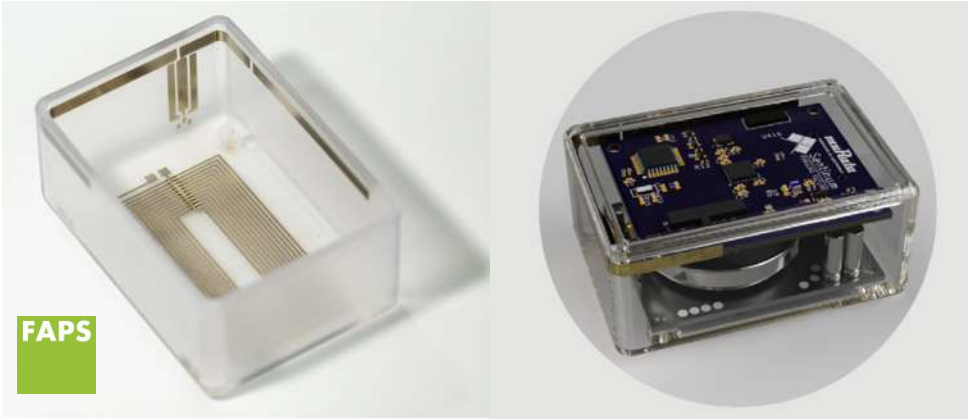
Multi-station Printing.
Courtesy: LITE-ON Mobile Mechanical SBG



Antenna for IoT Device

Project by Sentium/Murata/FAPS

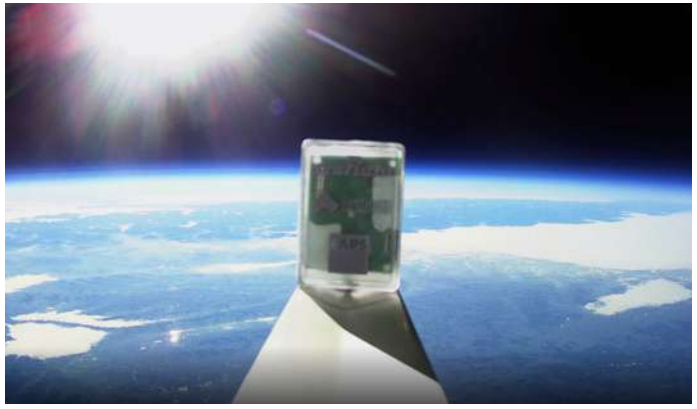
Combination of 3D PE with a multi-stack LPWAN IoT device to complete the mechatronic system.



Two Antenna printed on PC housing for the IoT Device:

- Base Antenna is NFC for writing and reading data to and from the device motherboard.

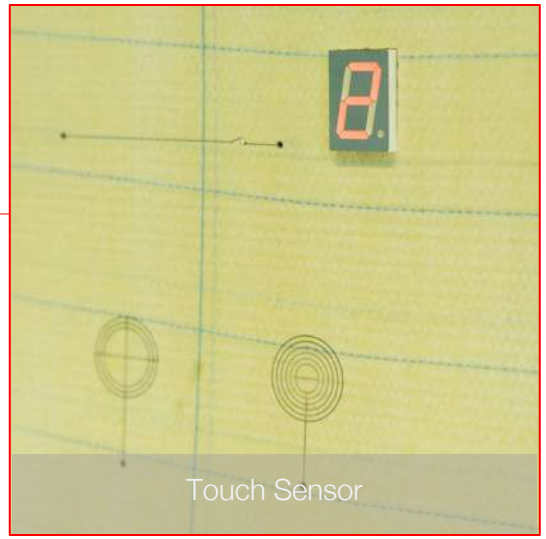
- Wall Antennas are combined LoRa (Long Range Wide Area Network) and NB-IoT (Narrowband Internet of Things) antennas for communicating with gateways.

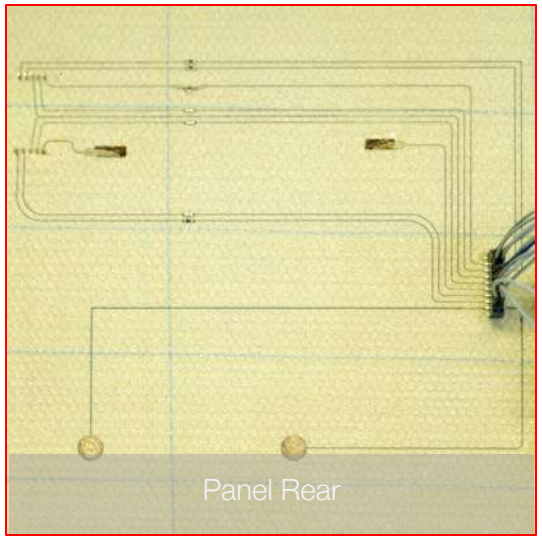


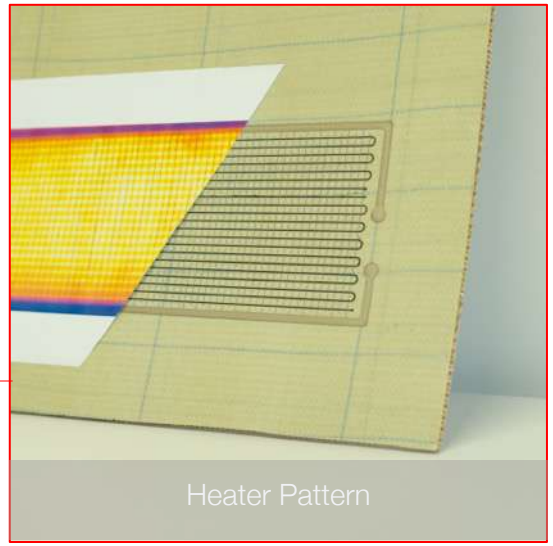
IoT device was sent into the stratosphere with a helium balloon.

The sensor covered a distance of nearly 200 km and reached an altitude of over 40,000 meters with sensor data as well as the position of the device could be monitored during the mission.

Commercial Aerospace - Smart Cabin Panel


Touch Sensor


Panel Rear


Heater Pattern

DLR FeVedis Project with Fraunhofer PYCO & FAPS

Healthcare - Printed Circuits & Sensors

After suffering a stroke patients are often accompanied by unilateral motor dysfunction resulting in weak finger strength, grip, and poor circulation.

The rehabilitation ball has printed circuits and embedded electronic components on curved, flexible substrates.

It is held in the palm of the hand for close-and-open exercises and effectively increases finger strength and stroke recovery.

The device provides real-time feedback the patient's grip strength and monitors the training process for patients.

Device developed and manufactured by EverYoung BioDimension Corporation

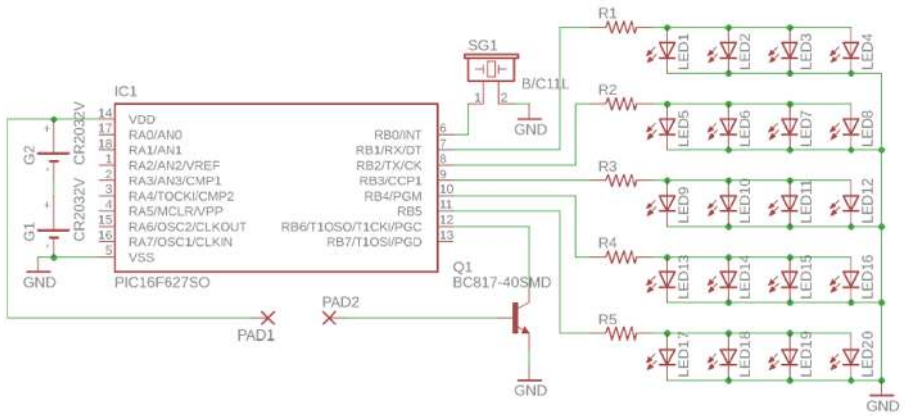
“Fully Additive” 3D Printed Electronics

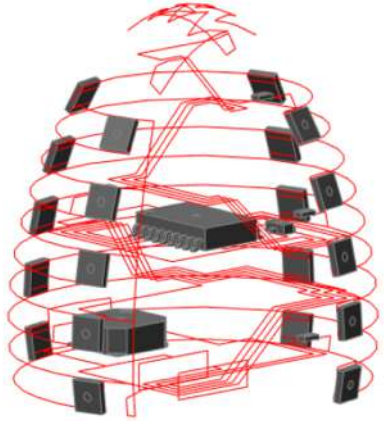
(Combining classical 3D Printing with Printed Electronics)

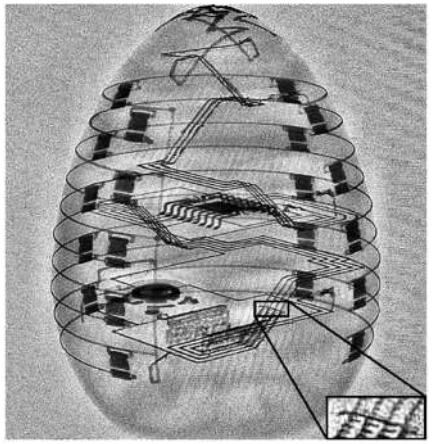
3D Printed Egg Timer

FAPS – University Erlangen-Nuremeberg

- FFF structural body
- Embedded PIC16F627 microcontroller and piezo buzzer for acoustic signals
- Touch switch realized by two comb-shaped pads and a transistor
- 20 LEDs on outer surfaces
- Conductive path cumulative length of 2m



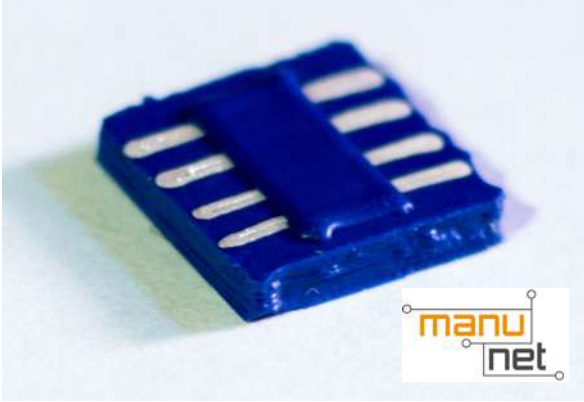




„Fully Additive“ 3D PE with Ceramic Substrates

1. EU Manunet Project AMPECS developed base process for Additive Manufacturing process for 3D Printing Electronics with Ceramic Substrates.

Cermaics based on LTCC analogue with embedded nano-particle Ag circuits.



2. Additive4Industry project PE3D Printed Electronics on 3D Substrates

Conti Temic microelectronic GmbH, FAU – Insitute FAPS, GSB-Wahl GmbH, TNO (NL)

Development of Additive Manufacturing processes for LTCC ceramic substrates with integrated circuit tracks for high temperature automotive applications including HF/antenna and sensor units.

Additive 4 Industrie

Bundesministerium für Bildung und Forschung

Grant number: 03INT709BD

CAD-CAM for “Fully Additive” 3D Printed Electronics

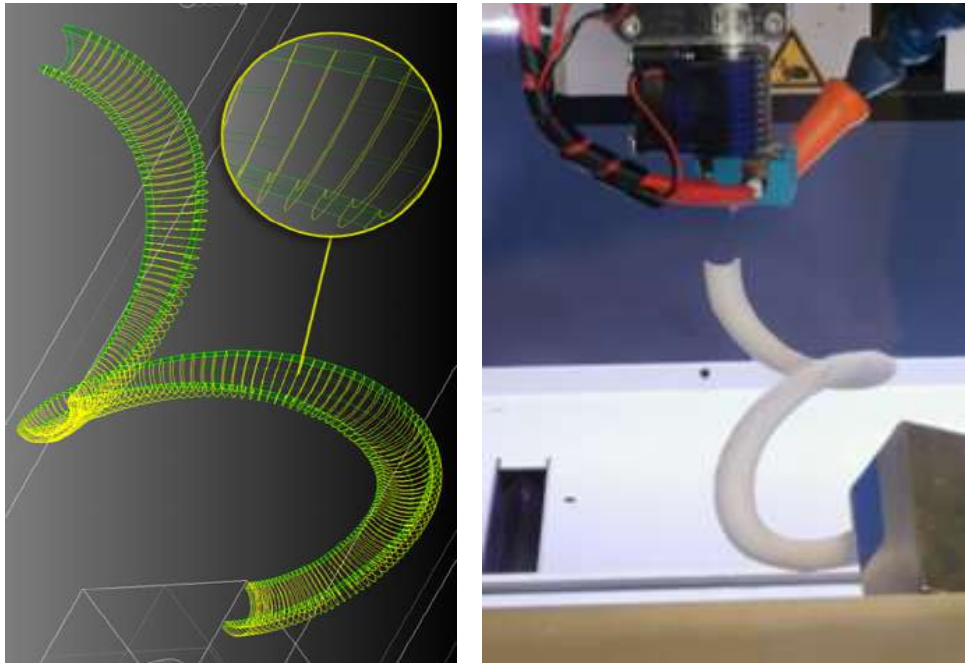
„Fully Additive“ requires that CAD-CAM has all tools integrated for each process step:

- AM Structural Body
- SMD Pick & Place
- Circuit and interconnect printing
- Post processing

Current Developments include:

1. Slicing for structural Additive Manufacture along multi-curved vectors to enable 5-axis printing parts without support material and

2. Methodologies for AM build on pre existing substrates with multiple degrees of curvature.



5-axis slicing procedure in Motion3D (left) and the printing process (right)

Automated QA – KAM EI Project

Development of a camera-based monitoring system for “Fully Additive” 3D Printed Electronics

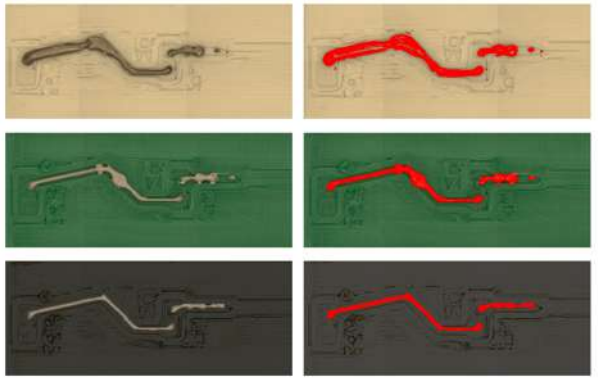
Record and classify the manufacturing process and automatically correct processing errors dependent on type:

1. Vision system will records the printed electrical structures in 3D space.

2. Images compiled, compensating for distortion and depth of field elements.

3. Artificial Intelligence (AI) to check for potential defects such as line breaks, short circuits and geometrical errors in width and thickness.

4. Defect is identified, one of three options that can be executed: automated correction, correction with operator input or part rejection (abort print).



Verification of the ink segmentation algorithm with different filament colours. (University of Hamburg)

Project funded by:

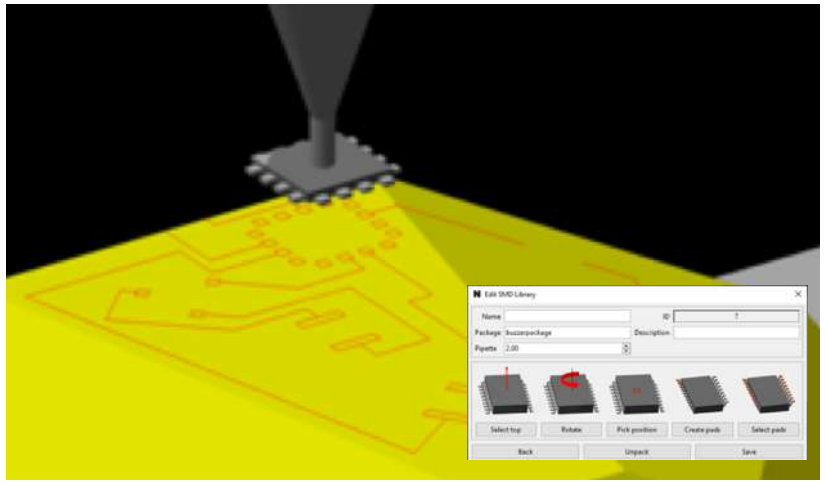
Bundesministerium für Wirtschaft und Energie

Timeframe:1.10.20-30-9.22

Neotech Products

Consist of 5 axis machine tools containing a variety of 3D capable print, pre- and post-processing tools with integrated software, training & service:

Print Platforms	Print/Functionalising Tools	Pre/Post-Processing
45X – multi head systems for volume manufacture	Piezo Jetting	CNC Machining
15X – “single” head system for R&D/Product Development	Aerosol Based	Plasma Cleaning
or custom size	Ink Jetting (Single & Multi-Nozzle)	Sintering (Light/Laser)
+ dedicated CAD/CAM Software Motion3D	Dispensing	UV Curing
	FDM	Adaptive Tool Path Vision System
	SMD Pick & Place	Laser Ablation



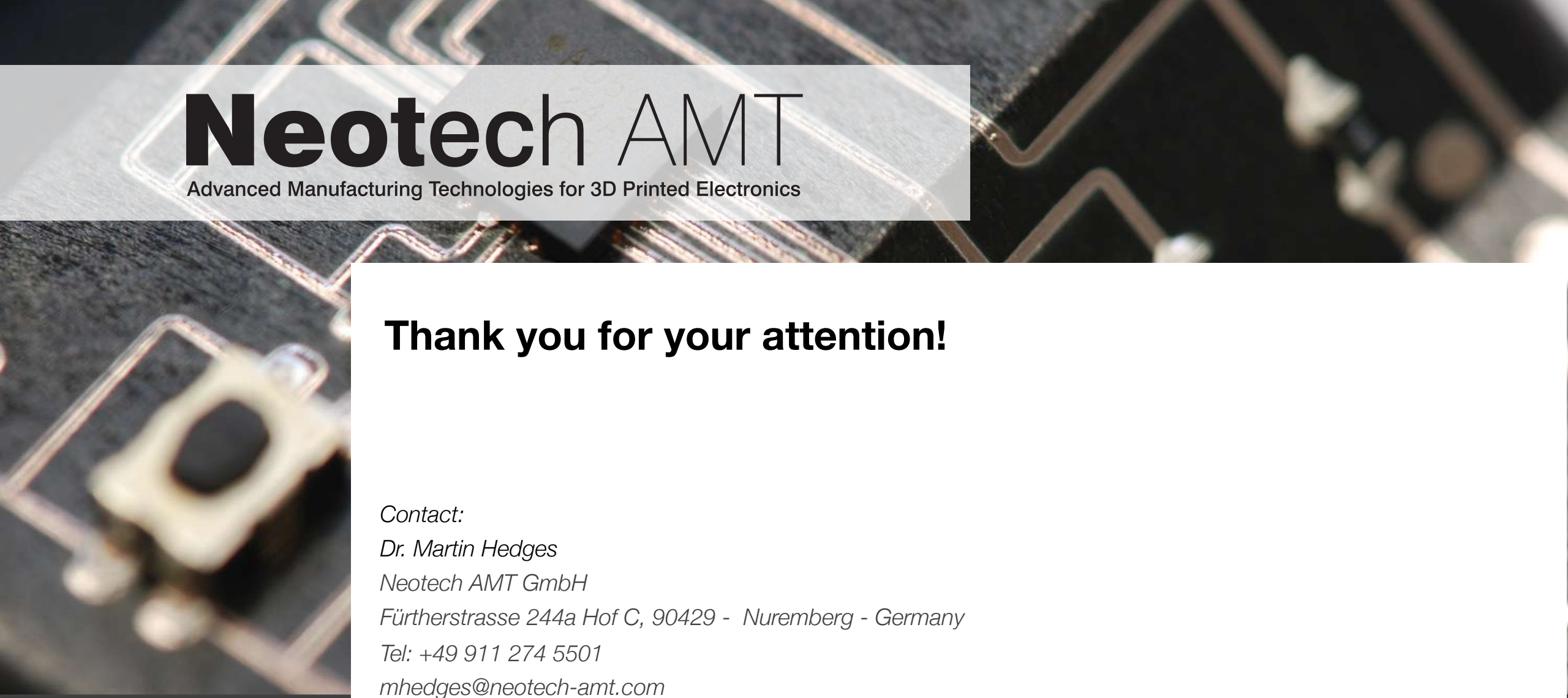
SMD P&P in Motin3D Software

Summary

1. Scalable process chains in 3D Printed Electronics

2. Printing on parts and “Fully Additive” 3D Printed Electronics

3. Current Application Examples



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Thank you for your attention!

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