



MINIATURIZED SENSOR PACKAGE FABRICATION FOR AUTONOMOUS DRIVING

An insight into the TINKER project

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Profactor GmbH – Some Facts and Figures











Our profile









This project has received funding from the European Union's Horizon 2020 research and innovation program under the Grant Agreement n°958472, project TINKER.







Sensors in cars



https://www.thegeospatial.in/uploads/images/image_750x_5cfe4adb0d535.jp



Levels of autonomous driving



https://thumbs.gfycat.com/FastDiligentHarlequinbugsize_restricted.gif



https://www.autodrivetech.com/solutions/automytive-oems/



https://giphy.com/gifs/disneypixar-pixar-disney-WApIcI7whuH3W



<u>https://i.pinimg.com/originals/49/50/73/4950</u> <u>73b26b5f1bc1f697476ef6c7f9e8.gif</u>



https://i.pinimg.com/originals/14/ff/56/14ff56cf7 75a715fb258f5b9db6092a0.gif





Motivation

- Market need (sensor packages)
 - Lowered weight
 - Lowered power consumption
 - Improved performance and reliability
 - Improved safety of ADAS systems
 - Improved resolution and precision

Industrial pull

Improved miniaturization level



https://image.slidesharecdn.com/yoleydms17054radartechnologiesforautomotivesample-171128151939/95/radar-technologies-for-automotive-2018-report-by-yole-dveloppement-18-1024.jpg?cb=1511882538

Standards:

Transport and Traffic Telematics (TTT) –

- 24 Ghz: ESI EN 302 288
- 77Ghz: ETSI EN 302 264





TINKER pilot platform

- Improving speed, accuracy and reliability of pick and place assembly techniques
- Improving automation level, process reliability and lowered rejection rate via feedback control
- Improved miniaturization level, fabrication time and efficient use of resources enabled by additive manufacturing

Manufacturing of RADAR and LIDAR sensor packages

- Miniaturization level
- Improving functionality
- Improving cost efficiency





https://link.springer.com/referenceworke ntry/10.1007%2F978-3-319-12352-3_17





PILOT PLATFORM



Bare die

- LIDAR
- RADAR



ASSEMBLY

Pick & Place

Bonding



Inspection

Compensation



ADDITIVE MANUFACTURING

Inkjet printing

Nanoimprint lithography



Sensor package

- LIDAR
- RADAR









How to achieve our goals?





Additive manufacturing -Inkjet

AM approach

- Material development
- Machine (inkjet, NIL) development
- Process development

Applications

- Direct integration of sensors assisted by inkjet printing
- (multilayer) PCB fabrication
- PIC fabrication
- Dedicated post processing







Toolings and pilot line parts for nanoimprinting



NIL overview



EVG HERKULES @LETI





SOFT-NIL Stepper @PROFACTOR



AM Outlook and current challenges

Novel materials for printed electronics



Hanan Markovich, Chief Business Development Officer, **PV Nano Cell**, on 'Complete Additive Manufacturing Solution for Mass-Production Printed Electronics', <u>Read more</u>

Inkjet printer pilot part



David Volk, Director New Applications, **Notion Systems GmbH**, on 'n.jet am – a flexible multi-material inkjet and laser platform', Read more



💈 pv nanocell

RADAR use case



Bernhard Polzinger, Research Engineer, **Robert Bosch GmbH**, on 'Multimaterial Inkjet Printing for Radar Waveguide Antennas', Read

more







Feedback control

Approach

- Inline inspection
 - Spectroscopic
 - microscopic
- Machine learning
 - Data processing and prediction

Application

- Self repair within pilot line
- Quality control
- Zero waste





Recent challenges in Feedback control



Utilize deep learning and high-resolution images to:

Extract gap shape and location



Criteria:

- Detection of gap location
- Detection of gap shape

Predict gap depths



- Criteria:
 - Mean Absolute Error compared to true depth





Assembly

Approach

La li

- Inline inspection
- Error measurements
- Prediction

Application

 Automated self correction of the process











Inspection in Pick and Place on test substrates within TINKER



Example of a placed die as seen by the machine; right: Fully populated and cured PCB with 6 modules





Duration

10.2020 – 09.2023

Consortium:

- 10 key industrial partners
- 3 research institutions
- 2 consultancy and service associations

Online pressence:

- Website: <u>www.project-tinker.eu</u>
- LinkedIn: linkedin.com/in/tinker-eu
- Twitter: twitter.com/project_tinker





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2021:

- setup of dislocated pilot line and supporting tools \checkmark
- Process and material development \checkmark

2022:

- Pilot line operational
- Fabrication of RADAR and LiDAR prototypes via pilot line

2023:

Demonstration and validation







Contact



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Thank you for your attention



