



Continental
The Future in Motion



**Digital Twin for strain measurement.
WOST 2024**

www.continental-automotive.com

Advanced Driver Assistance Systems

Digital Twin

Original

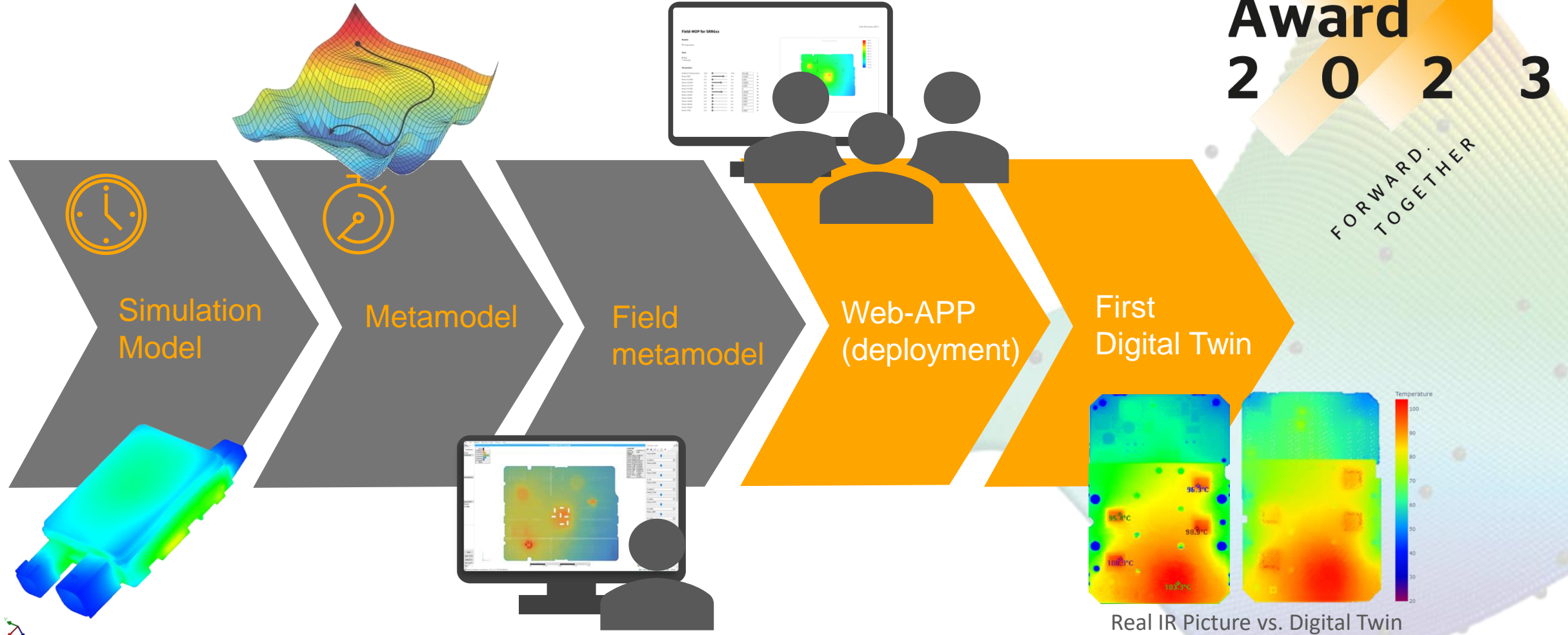
- › The first “**Twin**” appeared in 1960. It was a second spacecraft which remains on earth.
- › The first „**Digital Twin**“ is a virtual version of the spacecraft and appeared in 2010.
- › Nasa currently uses the Digital Twin for the **OSIRIS-REx** mission.
- › Digital Twins helps to **predict, detect, understand** and **optimize** missions.
- › By using real time data during the flight, it can be visualized what is actually happening on the asteroid “Bennu”, millions of kilometers away.



[OSIRIS-REx Mission Uses Digital Twin Technology - Bing video](#)

Digital Twin for strain measurement

Where we left off...

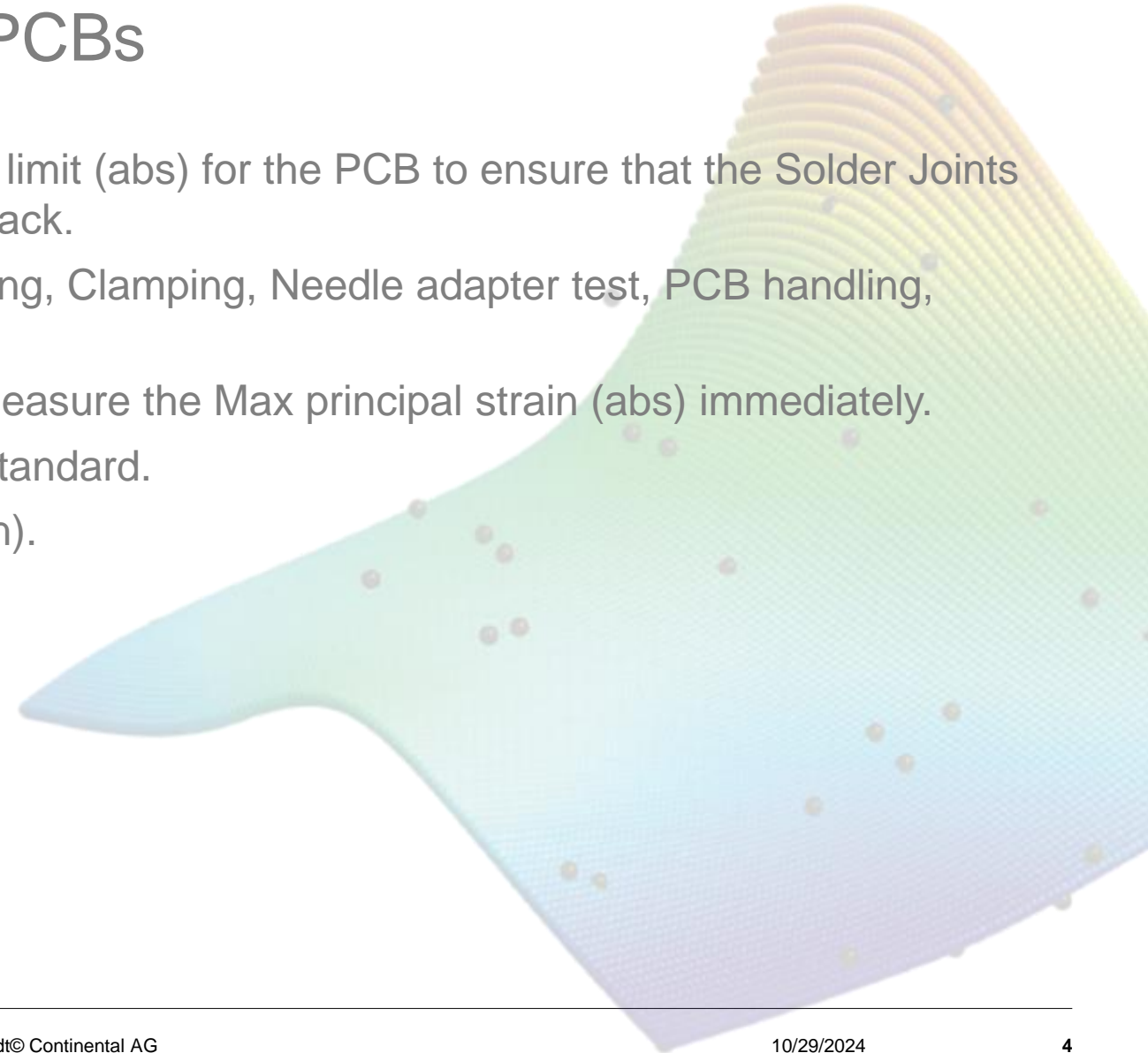
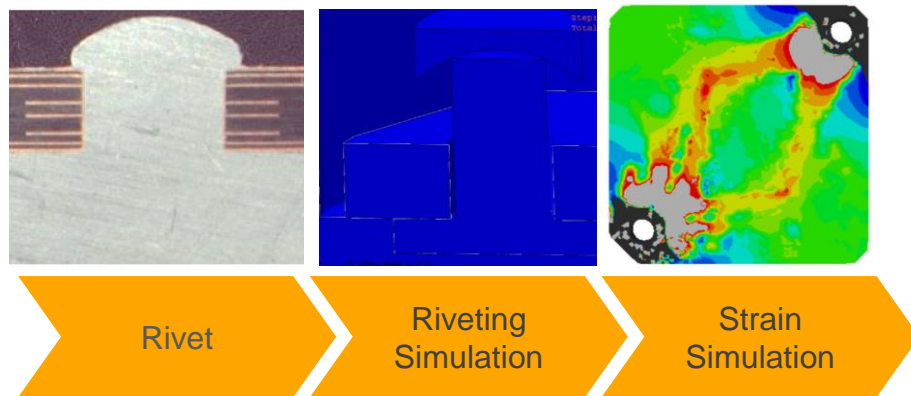


Digital Twin for strain measurement

Why Max Principal Strain (abs) on PCBs

- › JEDEC 9704 standard defines a Max principal strain limit (abs) for the PCB to ensure that the Solder Joints between electrical components and the PCB don't crack.
- › Max Principal strains are caused by Screwing, Riveting, Clamping, Needle adapter test, PCB handling, Connector Loads...
- › The standard requires rosette strain gauges which measure the Max principal strain (abs) immediately.
- › In general, the limit is oriented on the JEDEC 9704 standard.
- › A common limit in Continental is $1000 \mu\epsilon$ (microstrain).

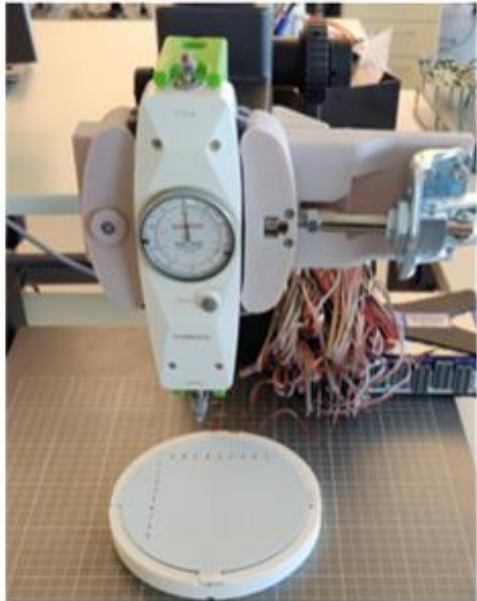
Example Riveting



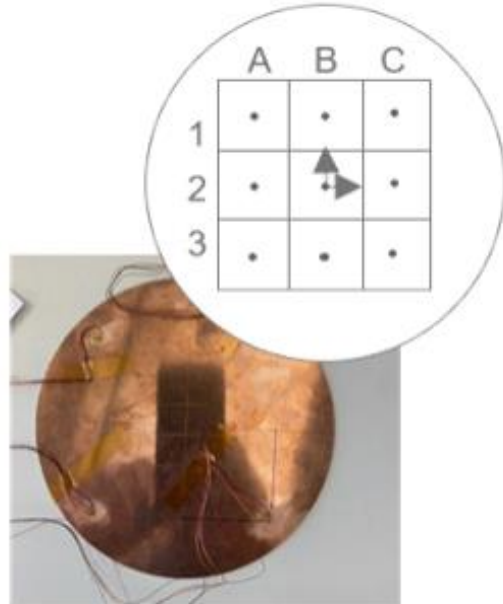
Digital Twin for strain measurement

Work 2023

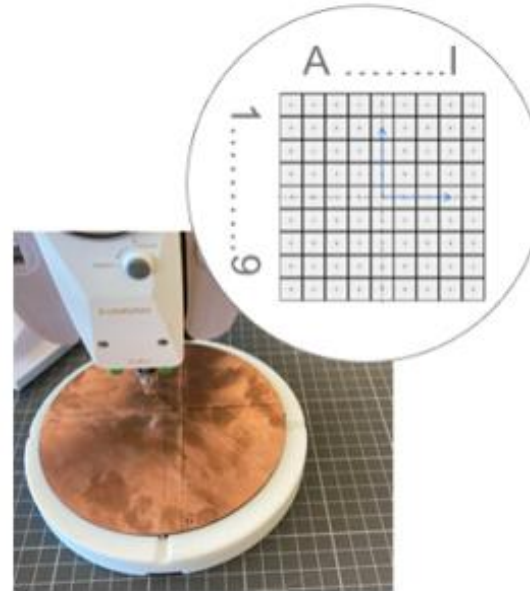
- › Target: Decided to let the Test person press the cone on a force location which we don't know. And Digital Twin predicts where he pressed.
- › First Demonstrator was a copper plate with 5 rosette strain gauges.
- › It was not possible to build a digital twin with copper plate and rosette gauges. – results from rosette gauges varied too much.
- › Copper plate with glasfiber measurement equipment reached the target.



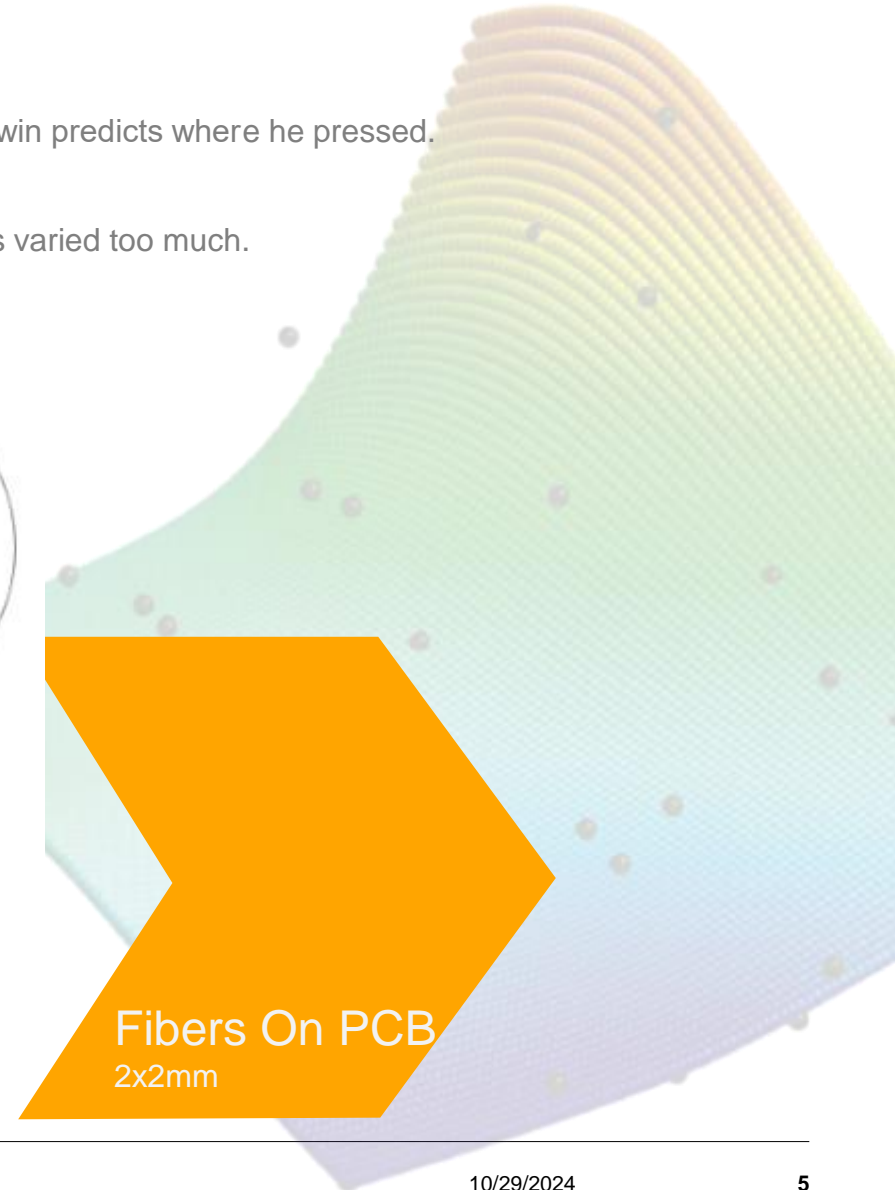
Demonstrator



Gauge Based
Prediction 20x20mm

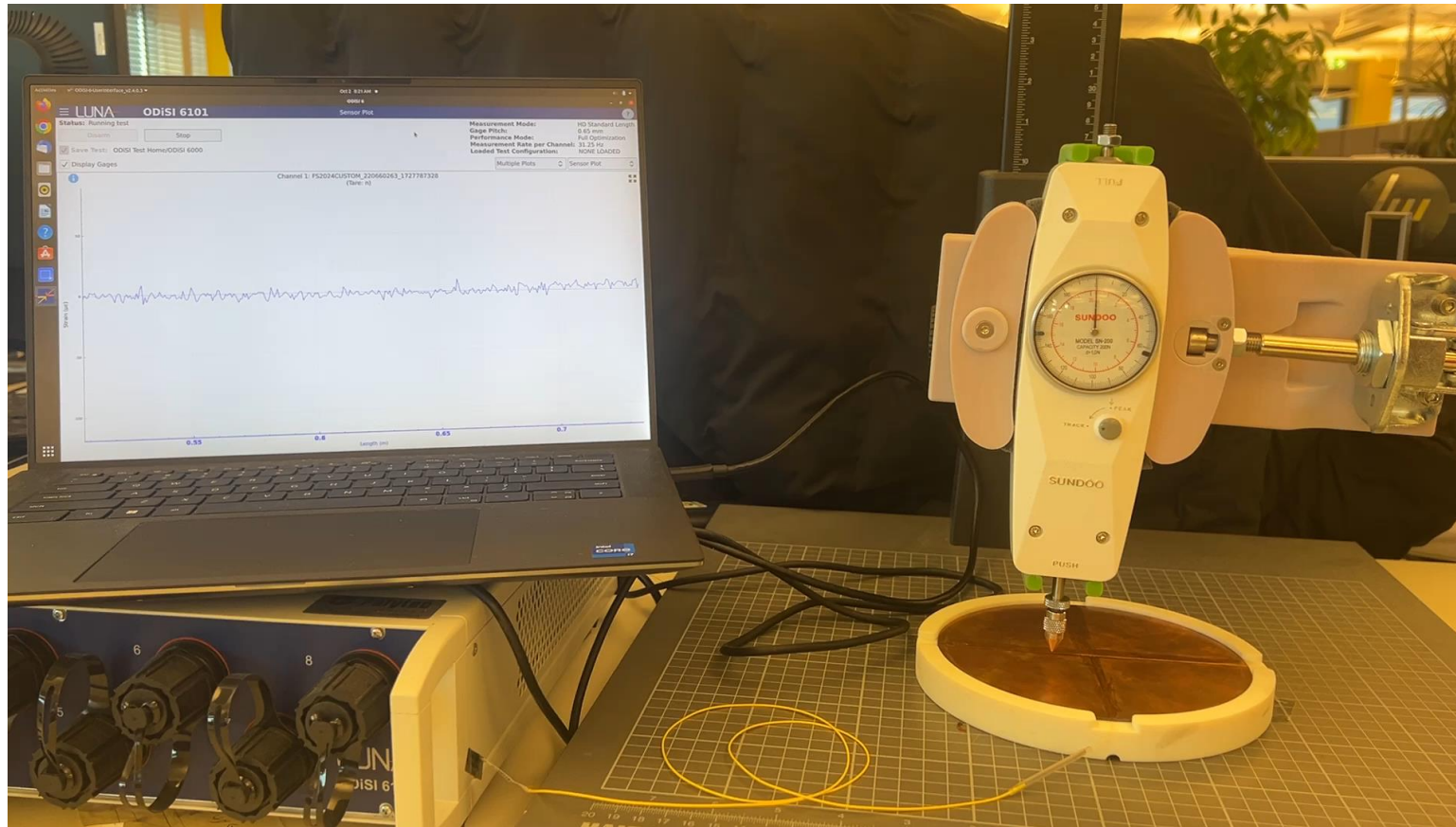


Fiber Base
Prediction 5x5mm



Digital Twin for strain measurement

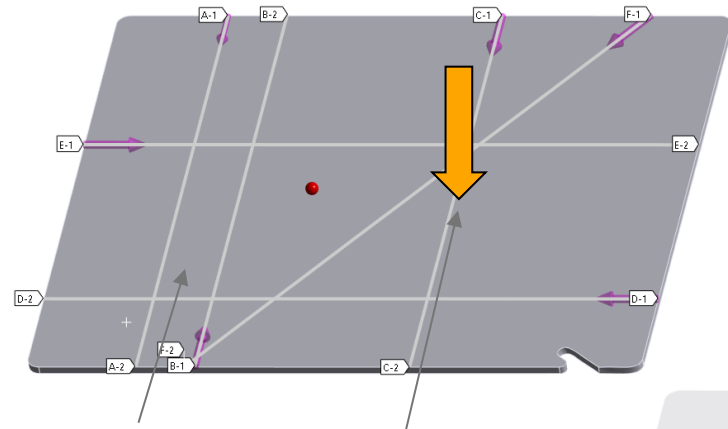
Strain measurement with glasfibers



Digital Twin for strain measurement

Simulation model

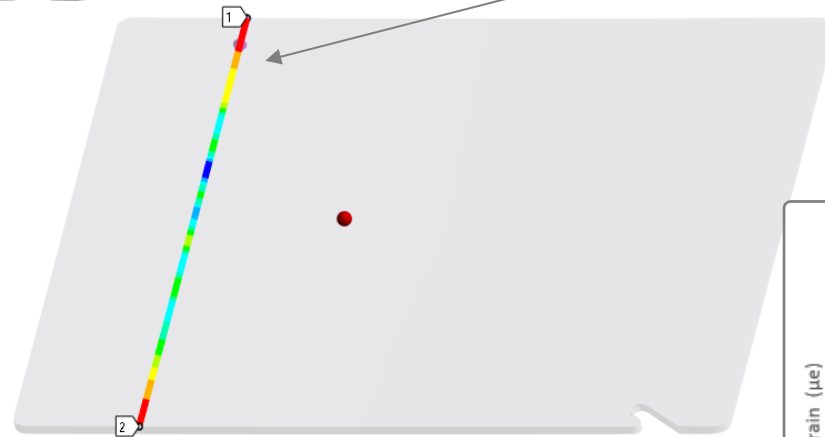
* Electrical components are not shown due to confidential reasons.



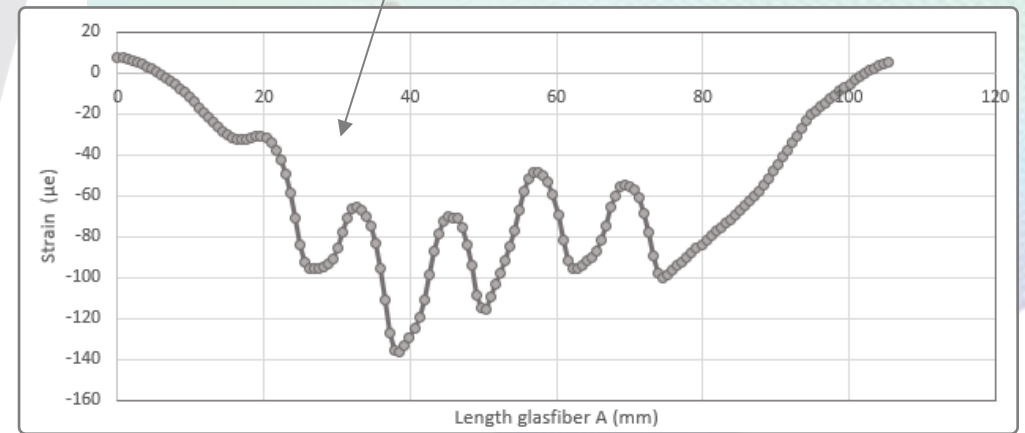
PCB

glasfiber

force



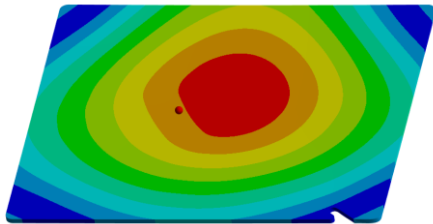
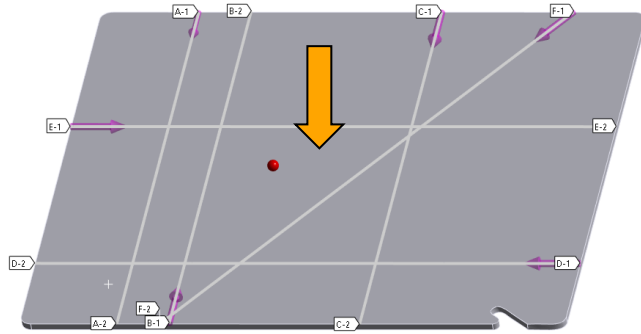
strain plot



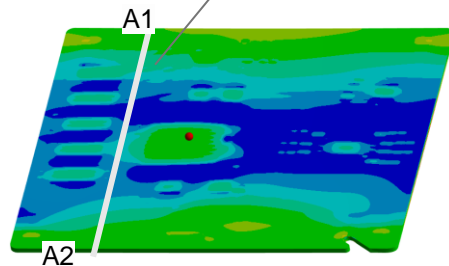
Digital Twin for strain measurement

Simulation model quality

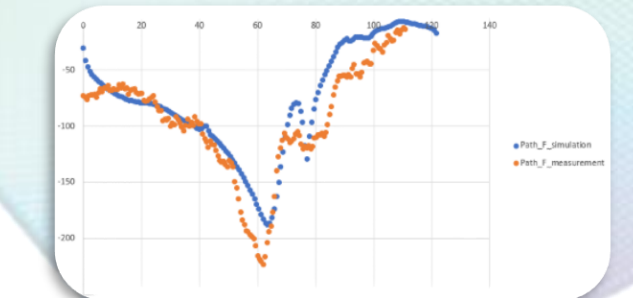
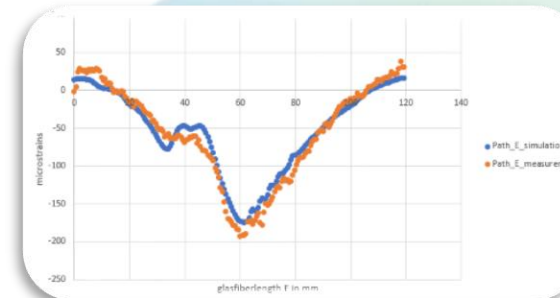
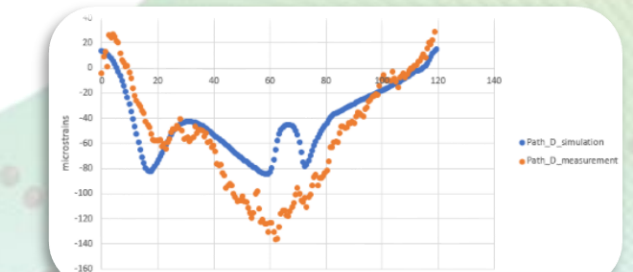
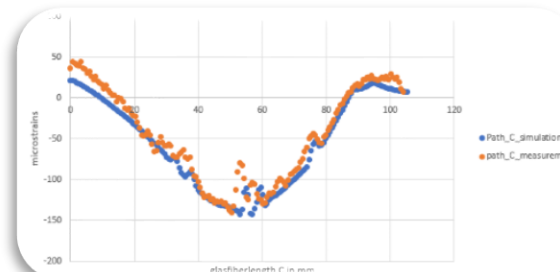
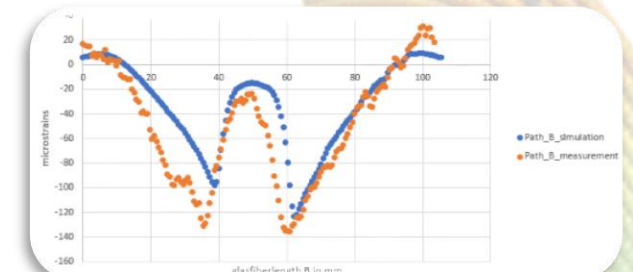
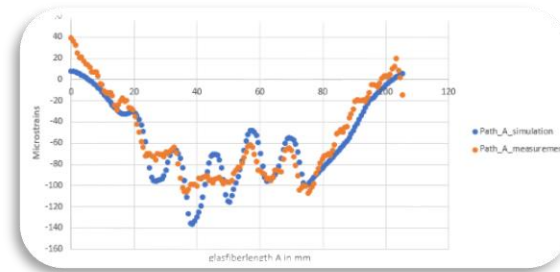
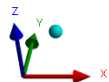
Electrical components are not shown due to confidential reasons.



Deformation



Normal strain in y-direction

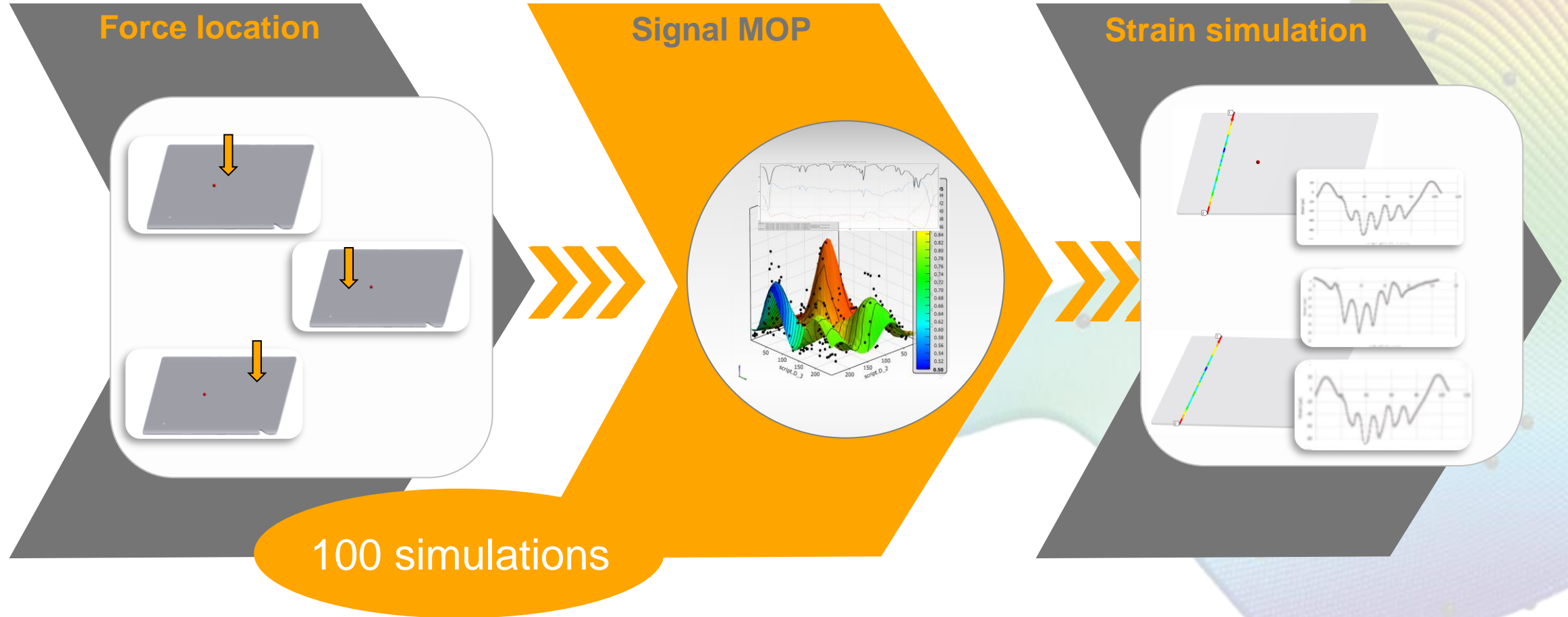


● - measurement

● - simulation

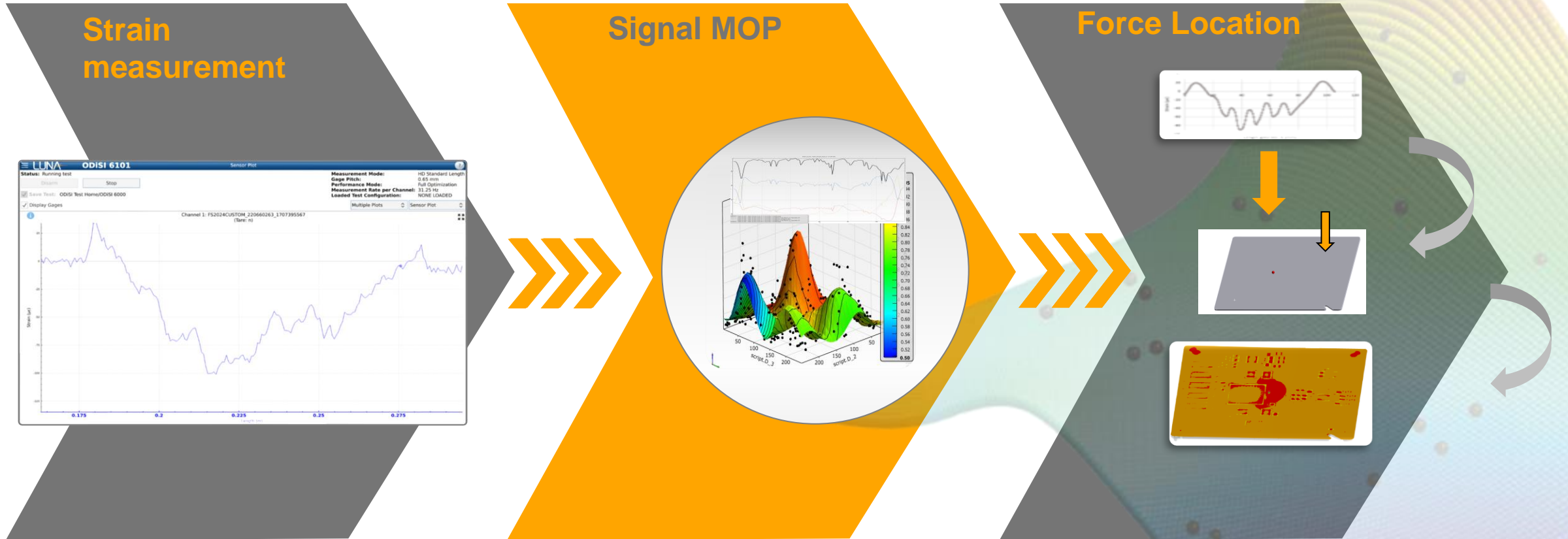
Digital Twin for strain measurement

Signal MOP

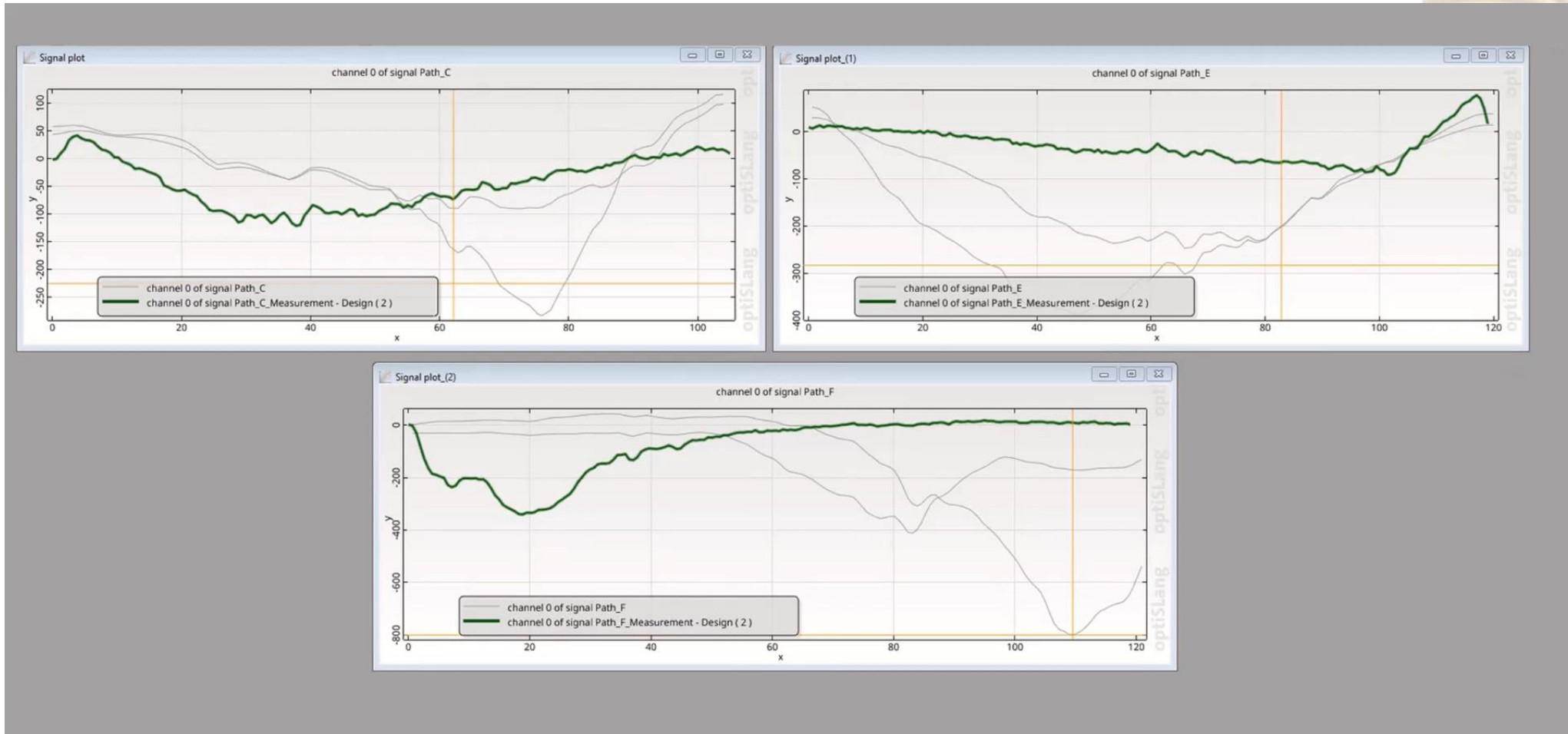


Digital Twin for strain measurement

Signal MOP

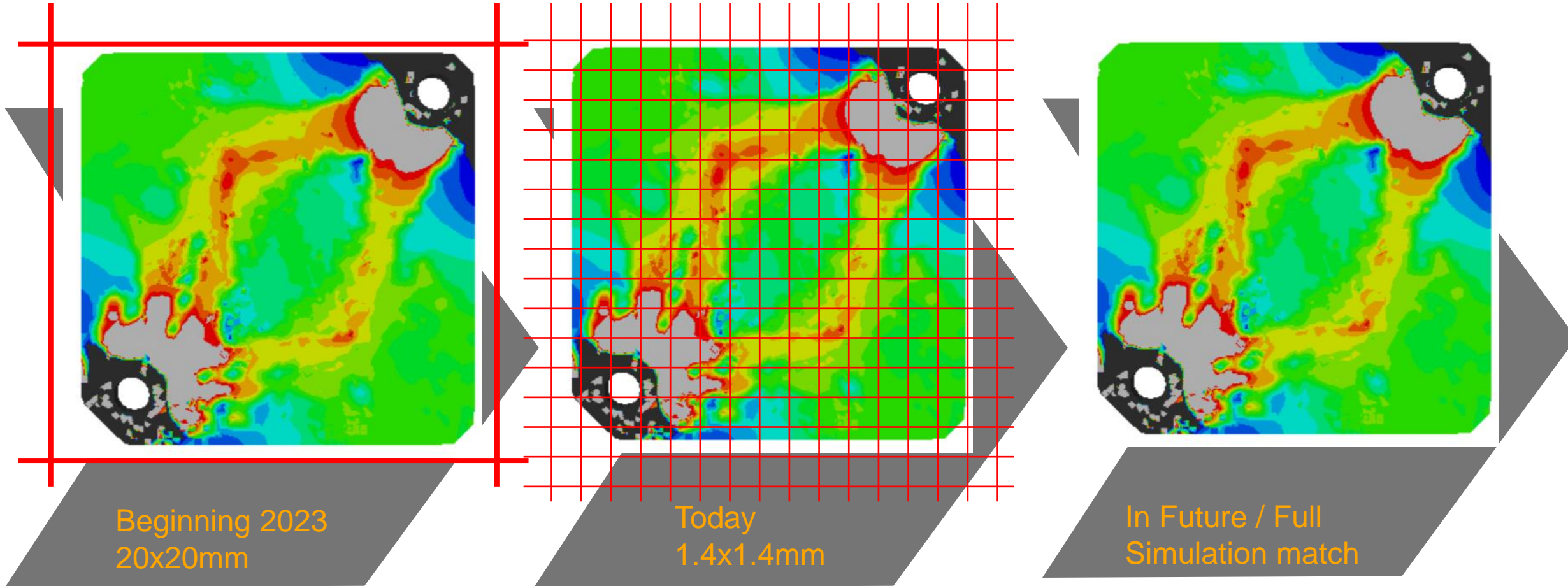


Digital Twin for strain measurement Optimization



Digital Twin for strain measurement

Prediction



Digital Twin for strain measurement

Standard Prozess vs. Digital Twin

