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Bundesministerium für Bildung und Forschung
BETREUT VOM
PTKA Projektträger Karlsruhe
Karlsruher Institut für Technologie
FORSCHUNGS CAMPUS
öffentlich-private Partnerschaft für Innovationen

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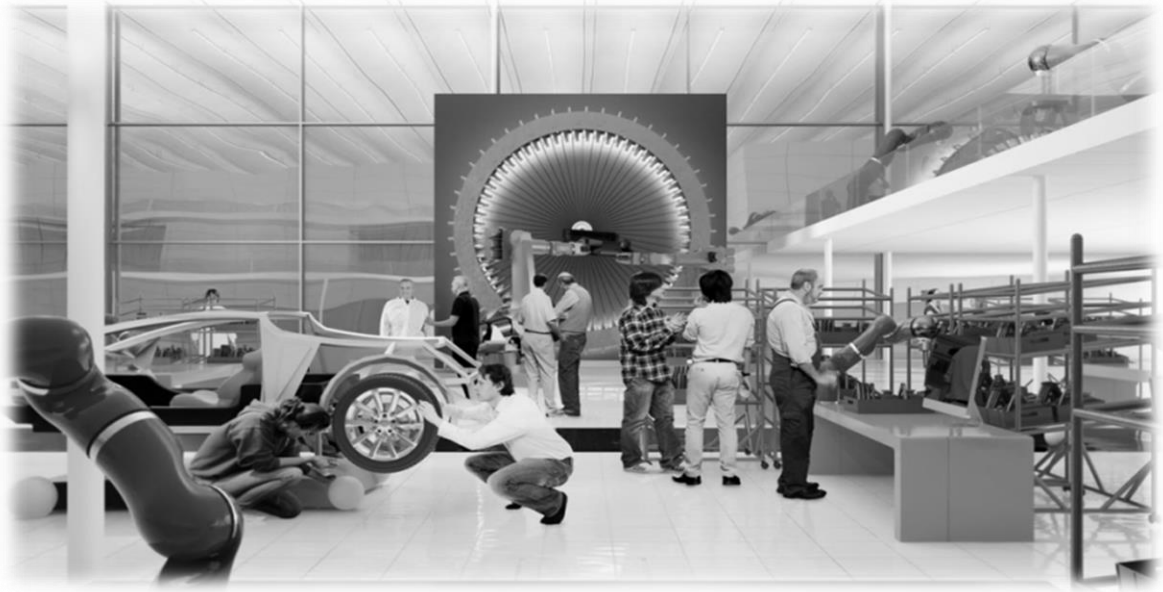
ABOVE & BEYOND

Dipl.-Ing. Jörg Dittmann



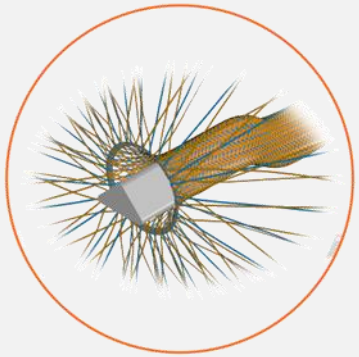
Strategic partnership for new innovations and research on a new level

Active Research Environment for the Next generation of Automobiles

- Development of Industry 4.0 with higher flexibility and reduction of energy consumption
- 3 technical projects + 1 cross sectional project

DigitPro
Digital Prototype

– Process simulation
– Virtual testing

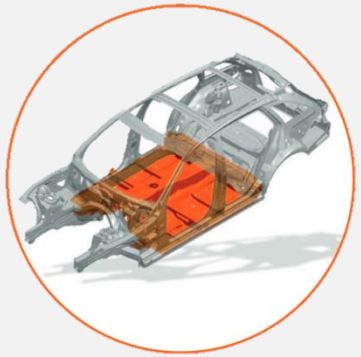


ForschFab
Research factory

– Versatile production of the future

LeiFu
Materials und construction

– Light weight materials
– Integration of functions



Khoch3
Creativity – Cooperation – Competence

ARENA2036 Scientific Campus in Vaihingen

19 partner out of science and economy areas

Active Research Environment for the Next generation of Automobiles

Scientific partner

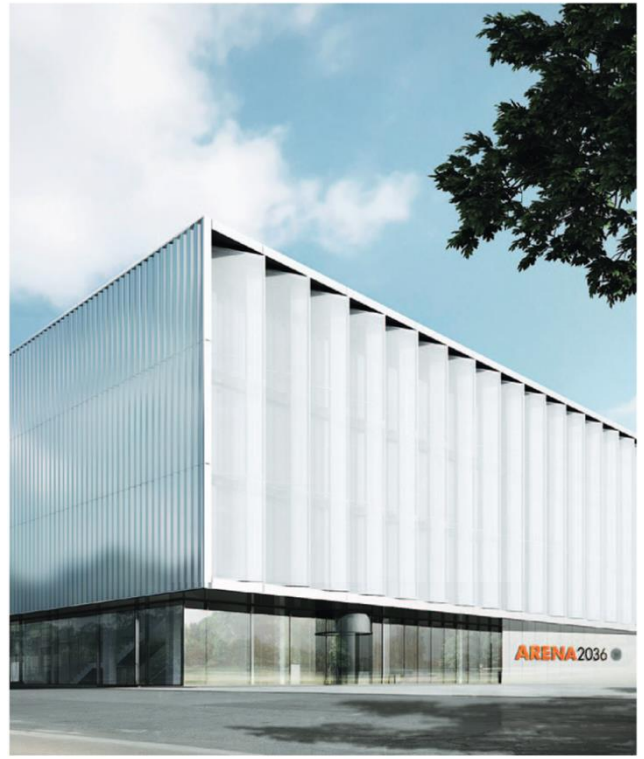
Universität Stuttgart
DLR
DITF DENKENDORF
Fraunhofer
FKFS

Commercial partner

Founders
DAIMLER
BASF We create chemistry
BOSCH Technik fürs Leben
BÄR

Partner
FARO
FESTO
KUKA
SCHUNK
pilz
csf
DYNA* MORE
Hewlett Packard Enterprise
SIEMENS
PLUGANDPLAY

In discussion
TRUMPF
EWS Tool Technologies *
LÜTZE
SICK Sensor Intelligence.
SCHMALZ
JOHN DEERE
MAHLE



ARENA2036 Scientific Campus in Vaihingen

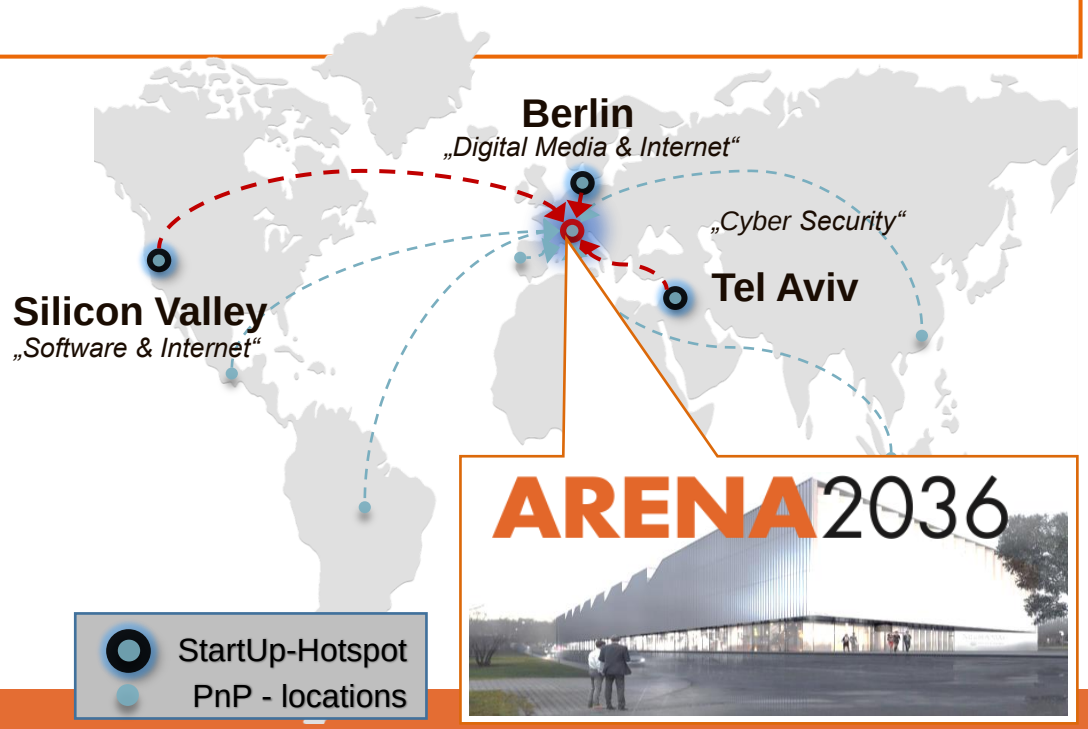
19 partner out of science and economy areas

Active Research Environment for the Next generation of Automobiles

PLUG AND PLAY
Silicon Valley in a Box®

- It´s more than an **accelerator** from Silicon Valley. PnP supports startups and companies which are already established and brings them together
- PnP is also an investor and supports more than 100 companies each year
- PnP is a global **innovation platform** with **22 locations around the world**

- International **Start-Up Scouting** with a focus on item topics like mobility and Industry 4.0 (especially hardware with software used)
- **accelerator-programm** includes mentoring, coworking-space and hardware lab
- **Open** for all industry partners



Active Research Environment for the Next generation of Automobiles

STARTUPAUTOBAHN

DAIMLER ARENA2036 Universität Stuttgart

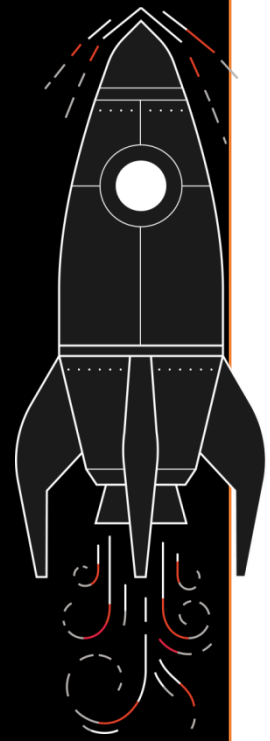
Future of Mobility, Vehicle & Transportation

- Biometrics for Identification
- Wearables - Potential use cases inside the vehicle
- How the vehicle integrates with connected home (nest)
- Tracking Movement/User Interaction
- Sensor Fusion inside the vehicle for user interaction
- Improving visual attractiveness
- Luxury/Premium mobility of the future
- New vehicle exterior/interior, adaptive/functional exterior/interior
- Predictive Analytics in terms of UI
- …

Future of Production / Industry 4.0

- Manufacturing / Manufacturing Equipment
- Site logistics / Autonomous logistics / Unmanned ground logistics
- IoT - Whole automation network / Industrial Internet
- Machine-Machine Communication
- New materials for automotive applications
- Machine learning
- UI/UX/Data Analytics
- Worker management
- Cyber security
- …

13 NEW Start-Ups



Teams from:

- Israel
- Germany
- Finnland
- Brasilia

APPLY & JOIN !!!

DigitPro – Digital Prototype

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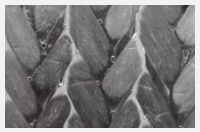
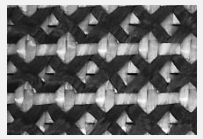
- Closed process chain
- From CAD design to final product
- Micro-, meso- and macroscopic modelling
- Different simulation tools
- HDF5 data Format

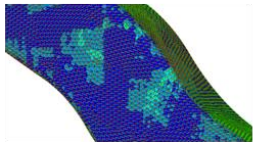
– Braided structures
– **O**pen-**R**eed-**W**eaving-structures

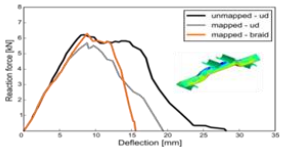


- 50 % Development time
- 10 % Weight



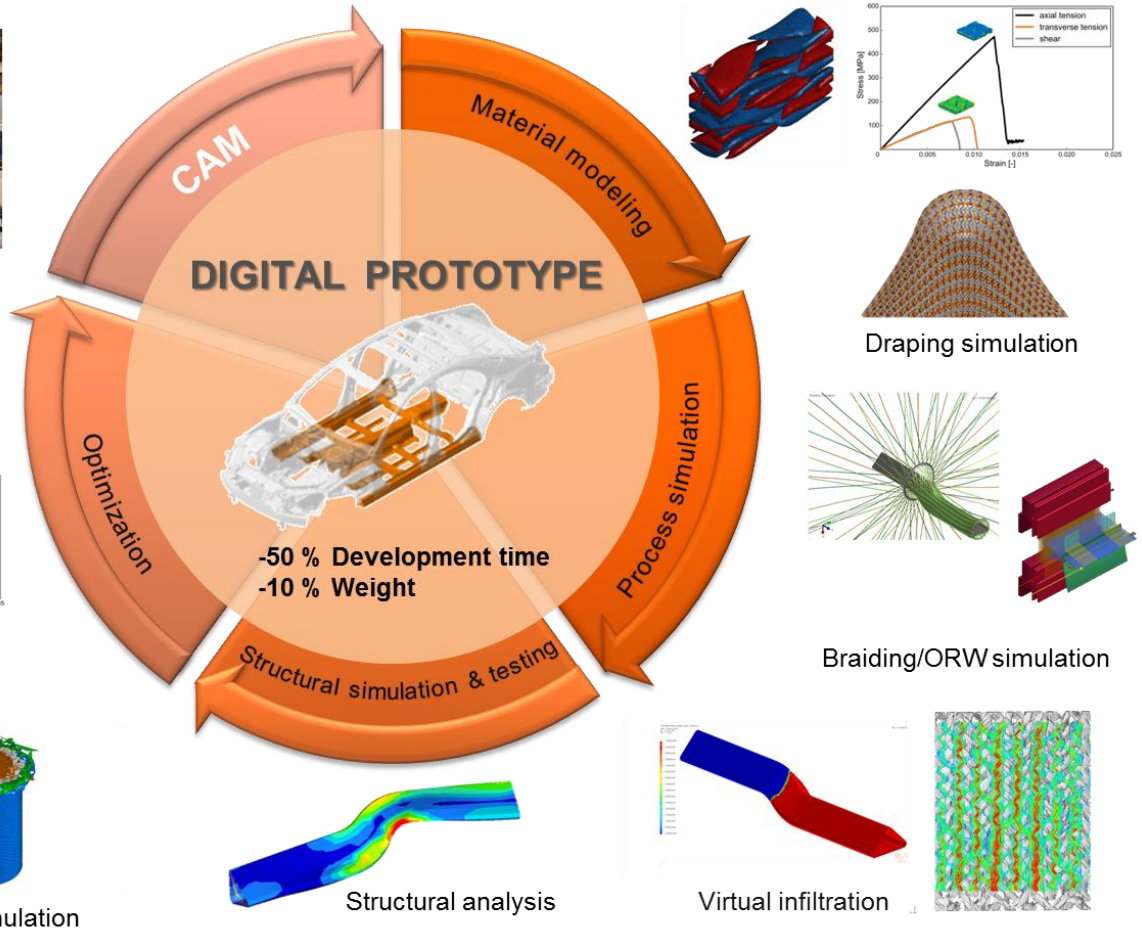
Robot control system





Optimizing load paths & structure evaluation

Crash simulation



Structural analysis

Draping simulation

Braiding/ORW simulation

Virtual infiltration

Numerical closed process chain for support of product design processes of FRP structures

ForschFab - Factory of the future

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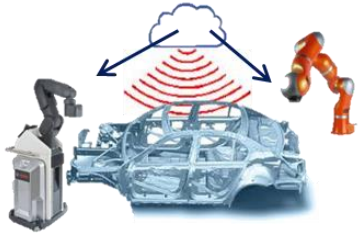
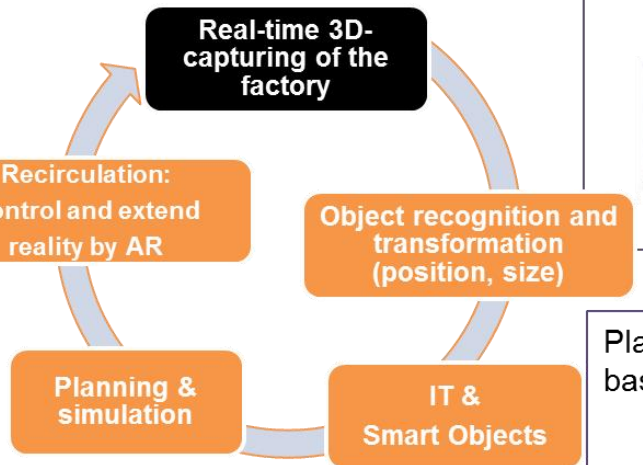
Navigation of autonomous units, as well as more flexibility and security for employees

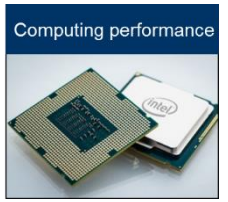
Constantly updated, 3D digital image of the factory

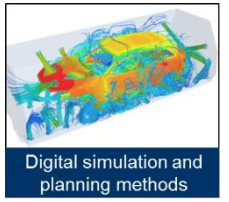
Environment awareness of robot, calibration and tracking



Planning, control, simulation, based on current data







A constantly updated, automatically generated image of the reality, which allows planning, control and optimization of all factory processes

Leifu - Intelligent lightweight engineering by functional integration

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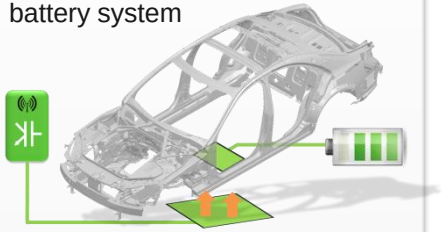
Approaches to be integrated scopes

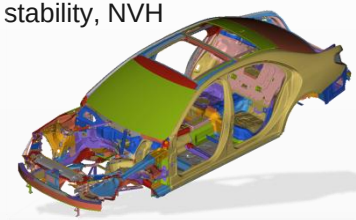
Electric

Inductive charging and battery system



Mechanical

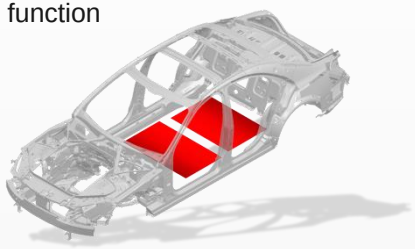
Improvement of stiffness, stability, NVH



Functions

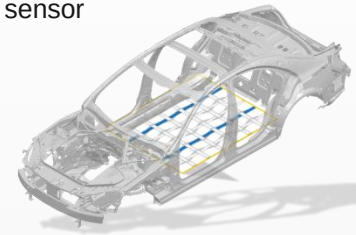
Thermal

Active heating and cooling function

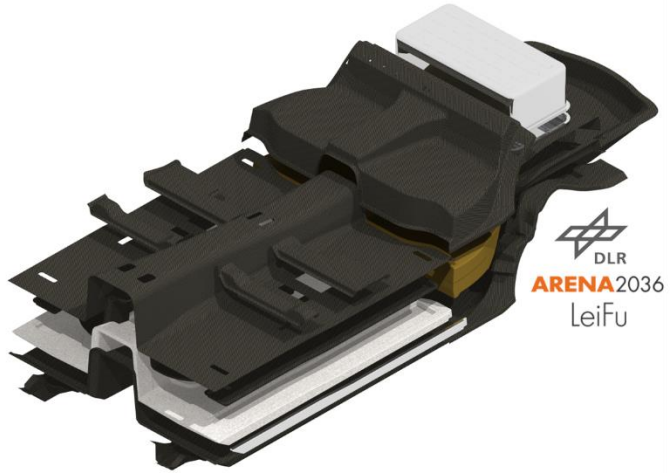


Sensors

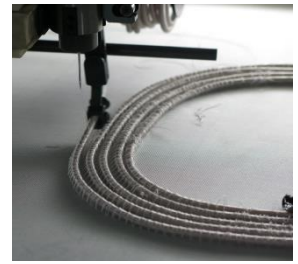
Structural integrated crash sensor



DAIMLER

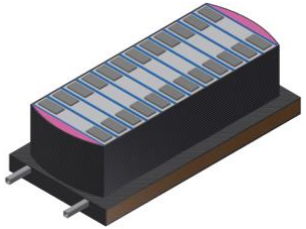


Concept for a demonstrator with functional integration

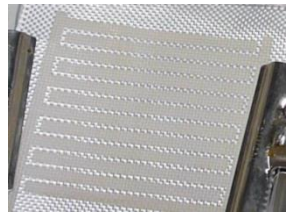


TFP process for inductive charging modules

Integration of carbon heating textile

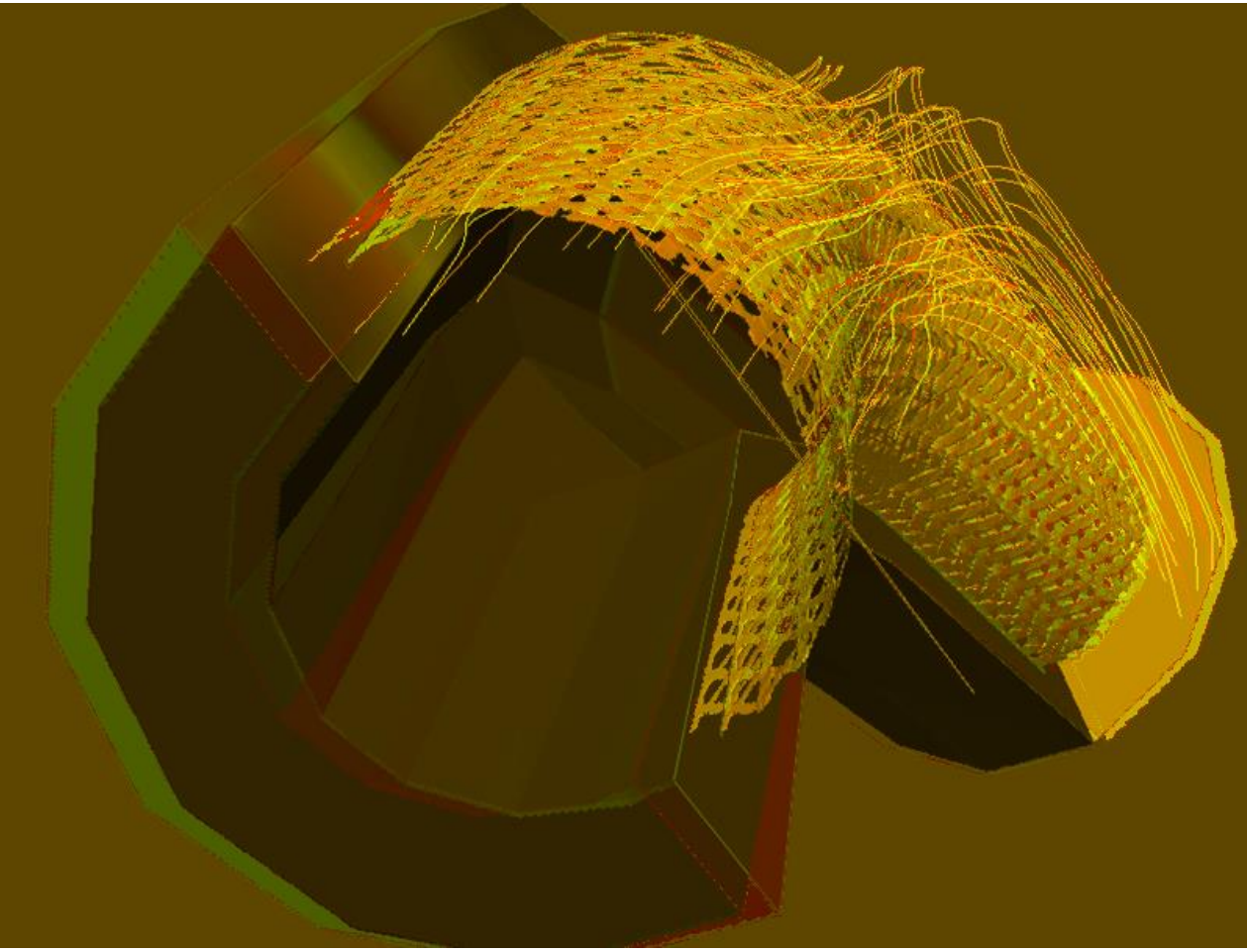


FRP battery housing with integrated sensors



Printed liquid detections sensors on textile preform

In LeiFu different approaches of functional integration are developed, implemented and evaluated on the basis of a FRP demonstrator module.

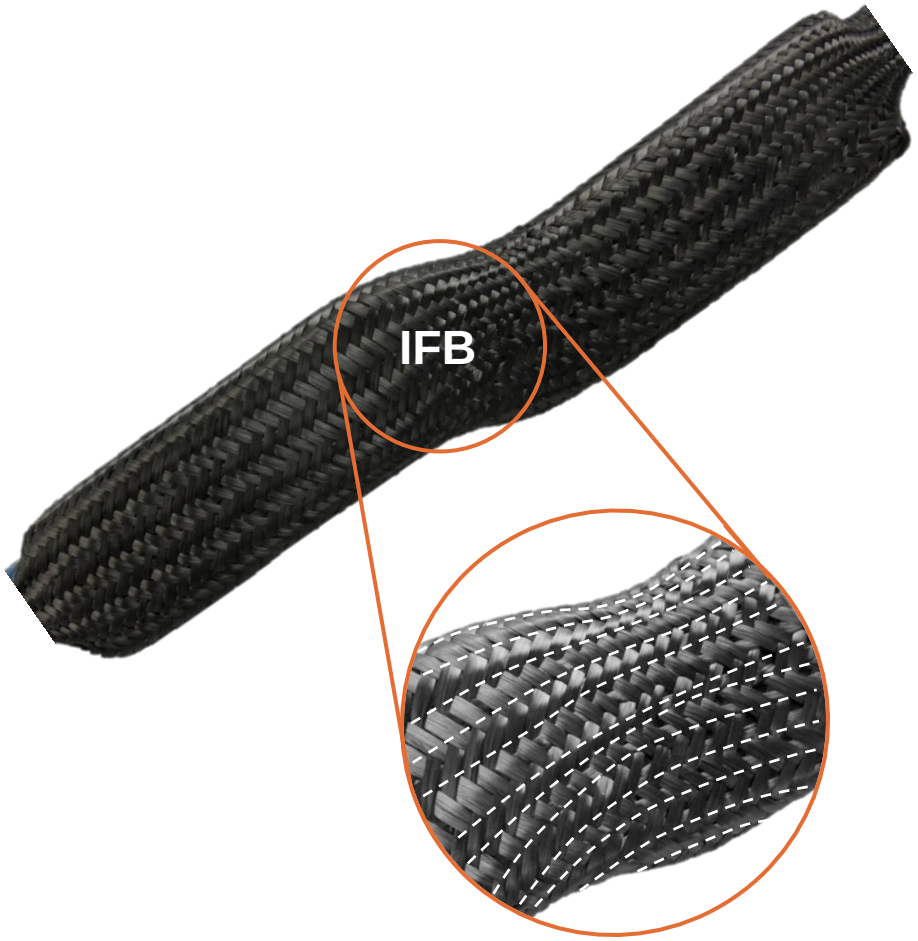


Virtual Permeability Determination

Jörg Dittmann
Institute of Aircraft Design (IFB)

DigitPro – Status Virtual Infiltration

- Permeability determination for 3D near-net-shape geometries in experiment not economical but essential
- Transfer of in-plane permeability measurments to 3D architecture not adequate
- How to simulate a complex 3D structure with varying fibre architecture?



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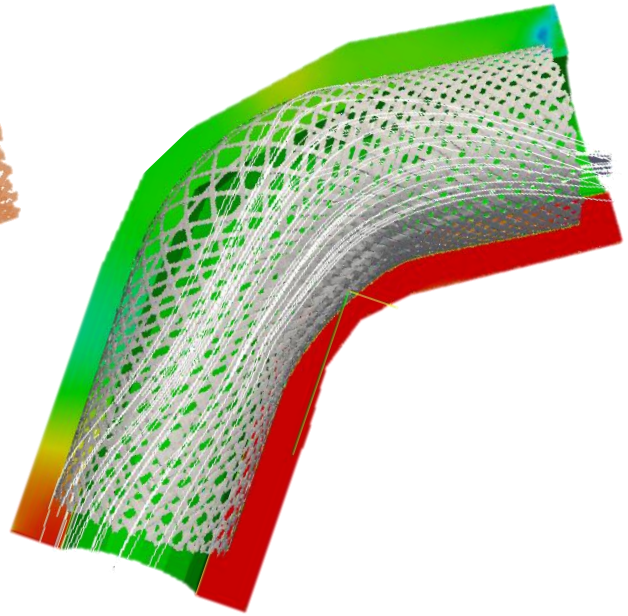
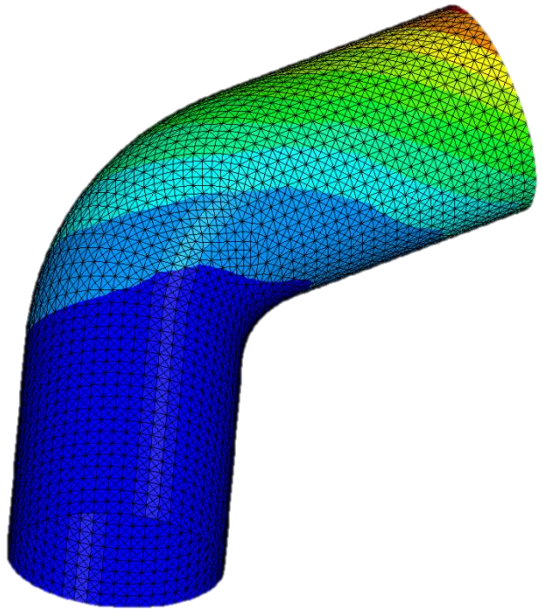
Textile preform

FEM textile architecture



Permeability prediction



FEM filling simulation

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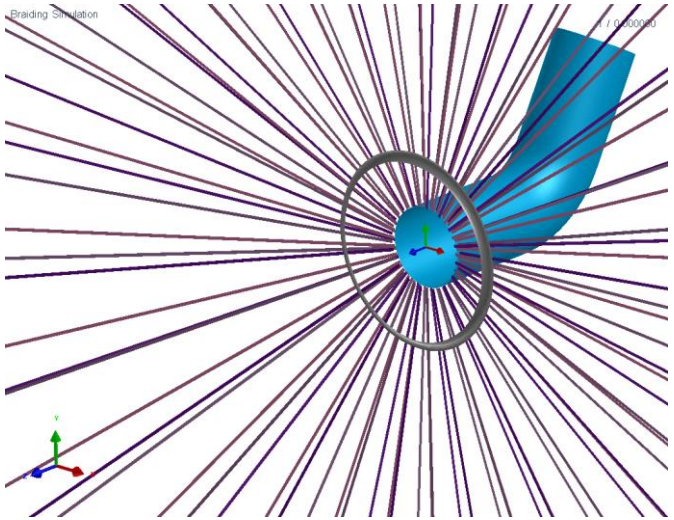
Mesoscopic braiding simulation

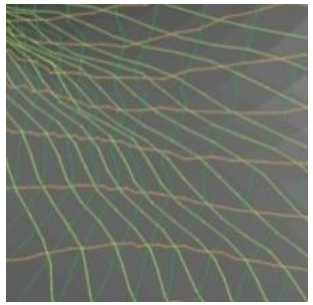


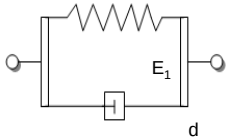
P. Böhler, D. Michaelis, F. Heieck, P. Middendorf. “Numerical Predicition and Experimental Validation of Triaxially Braided Fibre Architecture on Curved Mandrels.” TEXCOMP11, 2013

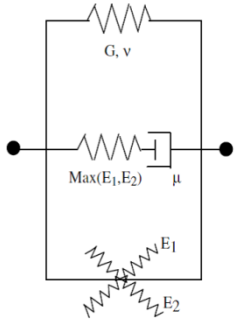
- Braiding simulation with PAM-CRASH

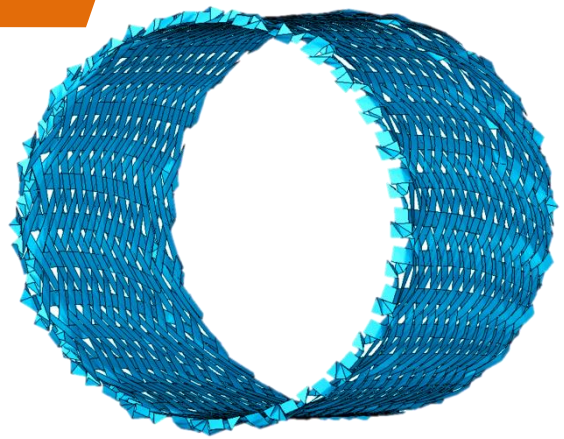
  Bar simulation: ~ Days, with 24 Procs

  Shell simulation: ~ Weeks, with 24 Procs









J. Dittmann, P. Böhler, D. Michaelis, M. Vinot, C. Liebold, F. Fritz, H. Finckh, P. Middendorf. „DigitPro – Digital Prototype Build-up Using the Example of a Braided Structure.” IMTC, 2015

DigitPro – Status Virtual Infiltration

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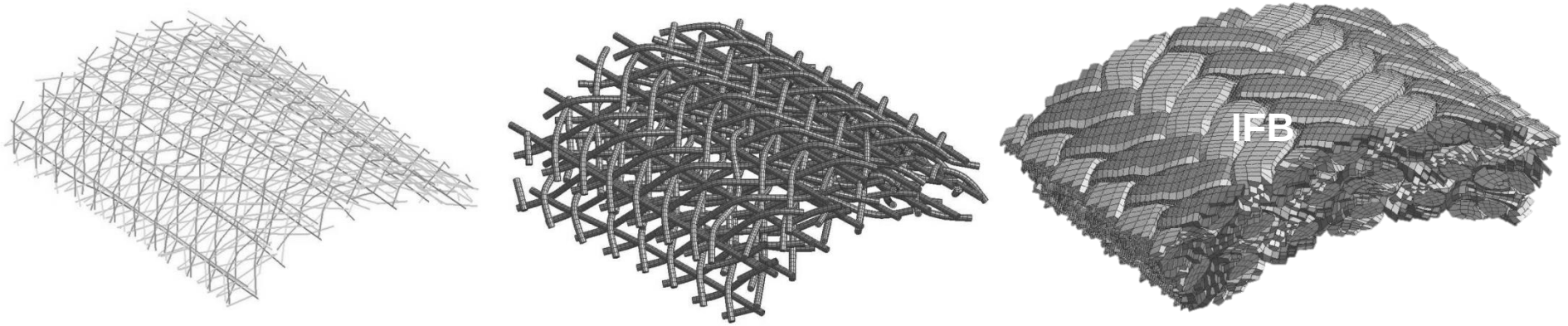
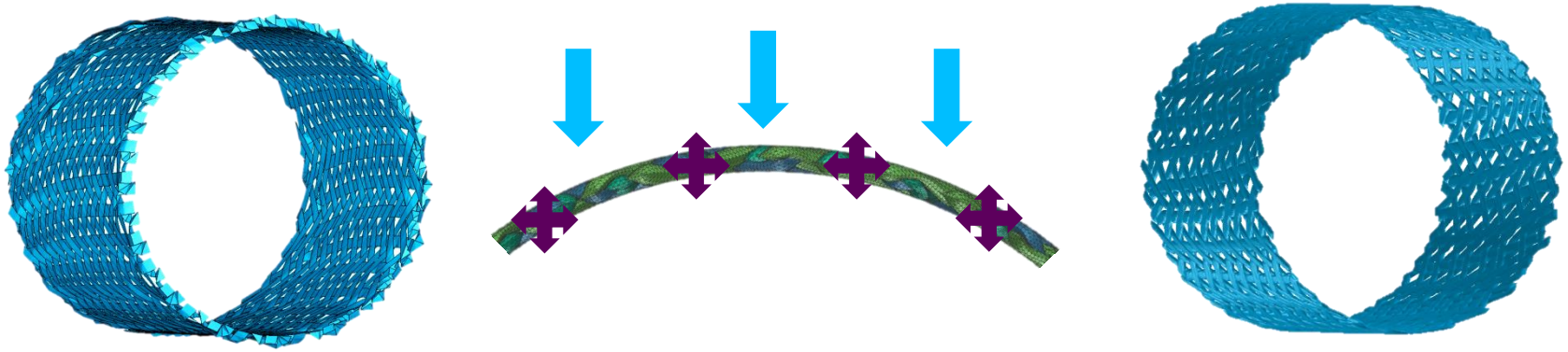
Braiding architecture



A. K. Pickett, J. Sirtautas, A. Erber. "Braiding simulation and prediction of mechanical properties.“ *Applied Composite Materials* 16.6 (2009): 345-364.



DigitPro – Status Virtual Infiltration

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Permeability prediction

Software:

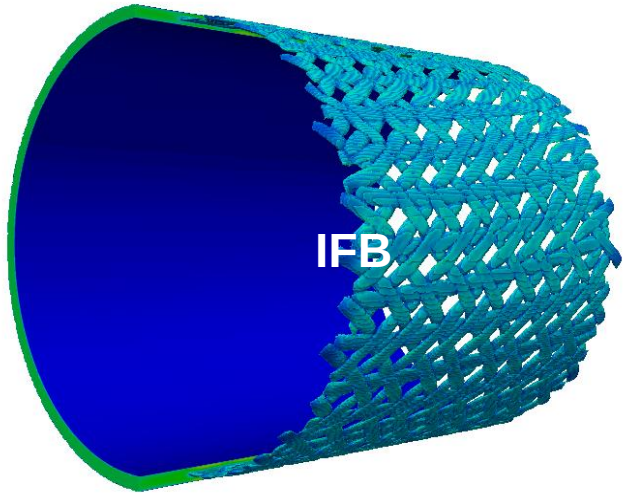
- OpenFOAM

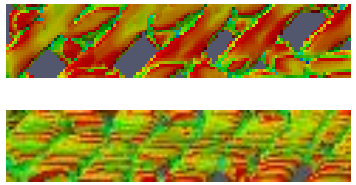
Utilities:

- 3dcalcPermeFoam (in-house post-processing)

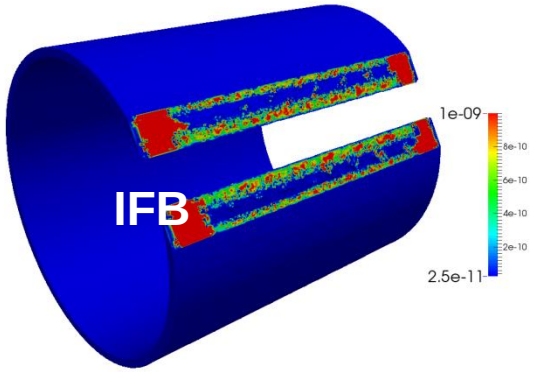
Solver:

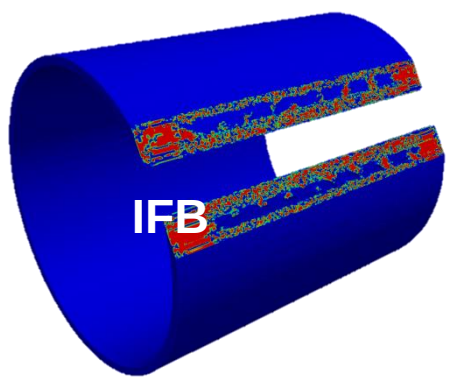
- Semi implicit pressure linked equation (SIMPLE)
- Boundaries:
- Pressure gradient: p = 2 bar
- Fluid dynamic viscosity: η = 109 mPas

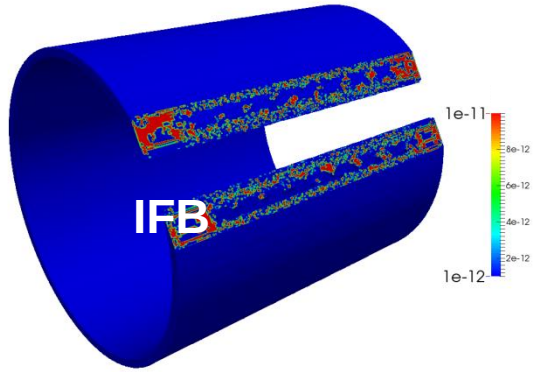




1layer sHm near-net-shape model







J. Dittmann, S. Hügle, P. Middendorf. „NUMERICAL 3D PERMEABILITY PREDICTION USING COMPUTATIONAL FLUID DYNAMICS" FPCM13 Kyoto, Japan, 2016

Large near-net-shape 3D permeability tensor field !!!

DigitPro – Status Virtual Infiltration

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Results overview

Textile	Layer [-]	VFC [%]	Permeability K_{xx} [m^2]	Meshing time [min]	Computational time [min]	Cell count [-]
Triax braid RVE (sHM/OF)	1	35	7.32e-09	14	60	3.4e+06
Triax braid RVE (Ansys/OF)	1	35	6.62e-09	20	107	3.9e+06
Triax braid RVE (sHM/OF)	3	44	6.29e-09	27	120	7.2e+06
Triax braid tube (sHM/OF)	1	24	9.73e-10	85	62	4.2e+06
Triax braid - radial in-plane experiment	2	49.2	7.67e-11*	-	-	-
Triax braid voxel RVE (Ansys CFX)	1	45	2.14e-09**	-	3	0.51e+06

* J. Dittmann, P. Böhler, D. Michaelis, P. Middendorf. „DigitPro – Validating The Link Between Braiding Simulation, Infiltration And Mechanical Testing.” ECCM, Munich, 2016

** E. Swery, R. Meier, S.V. Lomov, C. Hahn, P. A. Kelly, I. Straumit. „Verification of FlowTex Solver using Ansys CFX; Examining the Permeability Prediction Method on a Range of Textile Architecture Models.” ECCM, Seville, 2014

ARENA2036 DigitPro

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FORSCHUNGS
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öffentlich-private Partnerschaft
für Innovationen

PTKA
Projektträger Karlsruhe
Karlsruher Institut für Technologie

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