



RWTH, Peter Winandy

4D Textiles – morphing hybrid structures by additive manufacturing

David Schmelzeisen

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3

4



RWTH, Peter Winandy

Fiber based solutions **4** you

i4



INTERDISCIPLINARY



INTEGRATED



INDUSTRY-ORIENTED



INTERNATIONAL



4 Divisions

400 Employees

(Semi-) Finished parts



Natural & synthetic
fibrous material



Yarn

Fabric

Composite

RESEARCH AND SERVICE IN ONE HAND



INTERDISCIPLINARY



RWTHAACHEN
UNIVERSITY

Fiber based solutions 4 you



Knowledge-Transfer

Production

Information & communication

Building & living

Energy & environment

Mobility

Materials

Health

ITA Academy

aps GmbH

AME TE

Dream 2 Lab 2 Fab

AMIMB

TFI e.V. (GmbH)

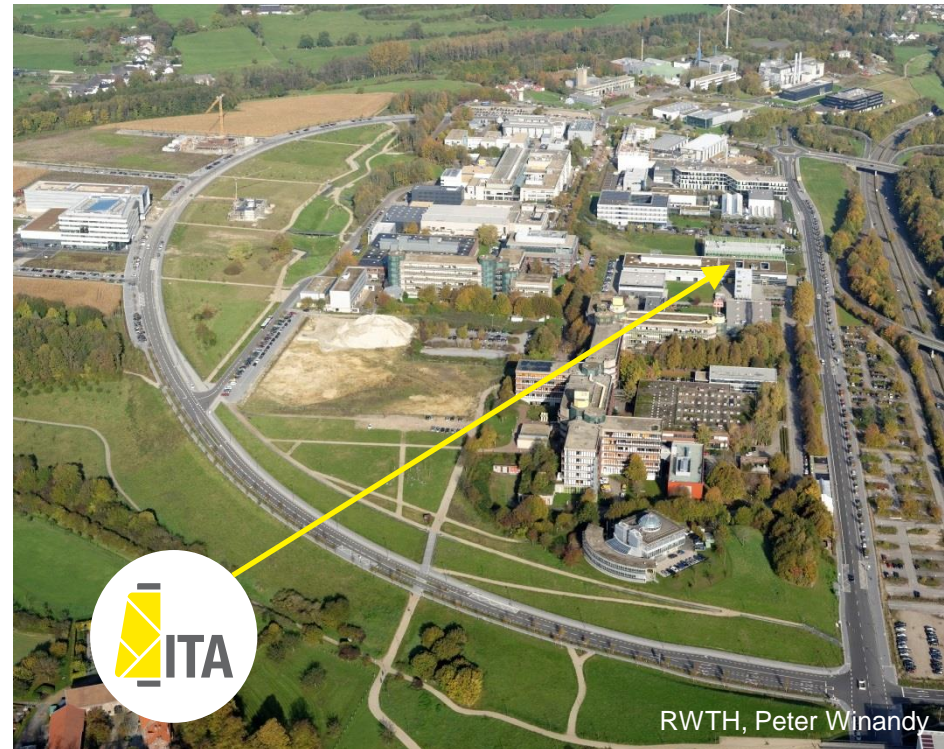
ITA Augsburg

ITA TR

RWTH Aachen Campus

RWTH Campus: a new kind of cooperation between industry and university

- Biggest technology campus in Europe
- Establishment of high-tech companies in 15 different clusters
- Exchange of research results, staff, other resources
- approx. **4** bill. € investments until 2020
- approx. 10,000 jobs in research & development





Geleen/NL

Istanbul/TR

4 International Locations

Suwon/Korea

Augsburg/Ger



4D

Textiles

4D Textiles – Vision



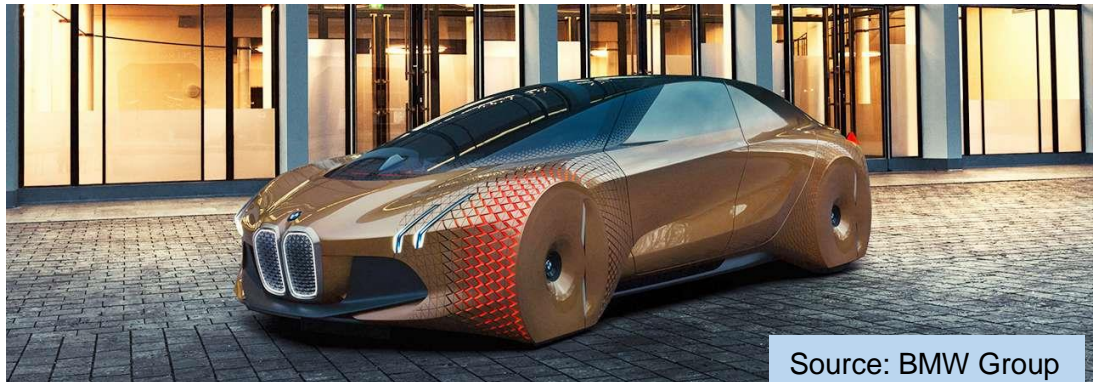
4D Textiles – Definition

What are 4D Textiles?

The term „3D Textiles“ has been defined by Wulfhorst et al. in 2000.

4D Textiles are fabrics and textile products being able to change shape and function over **time**. This change is achieved by the complex interaction between **hybrid materials** and by the use of **external stimulus**.

Additional to the spatial expansion of fabrics (3D) the change over time faces the **4th dimension in textiles**.



4D Textiles



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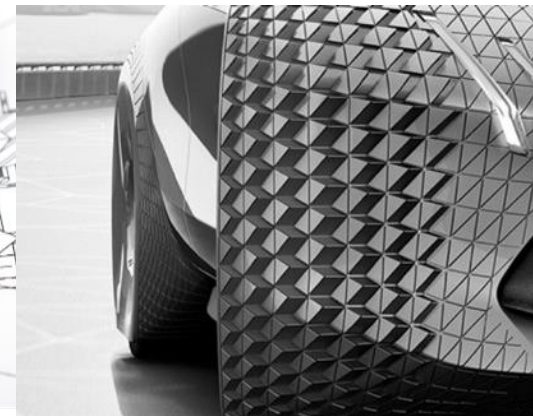
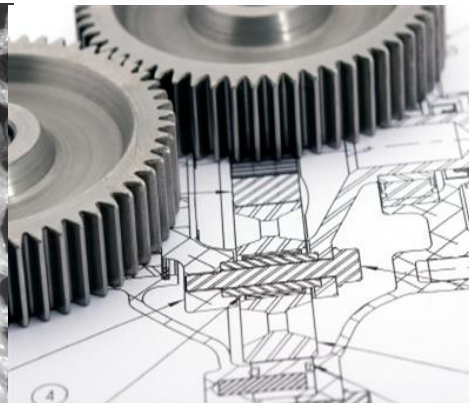
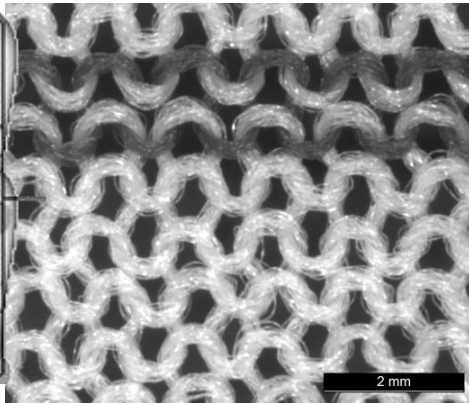
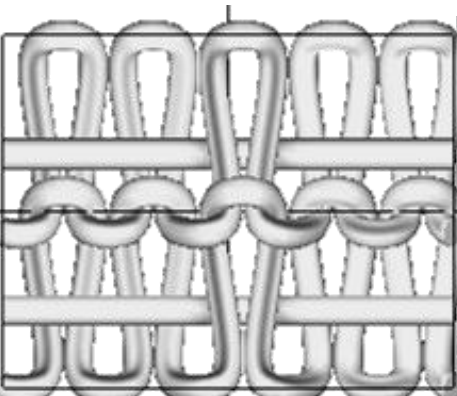
4D Textiles – Methods

Simulation

Trials/
Validation

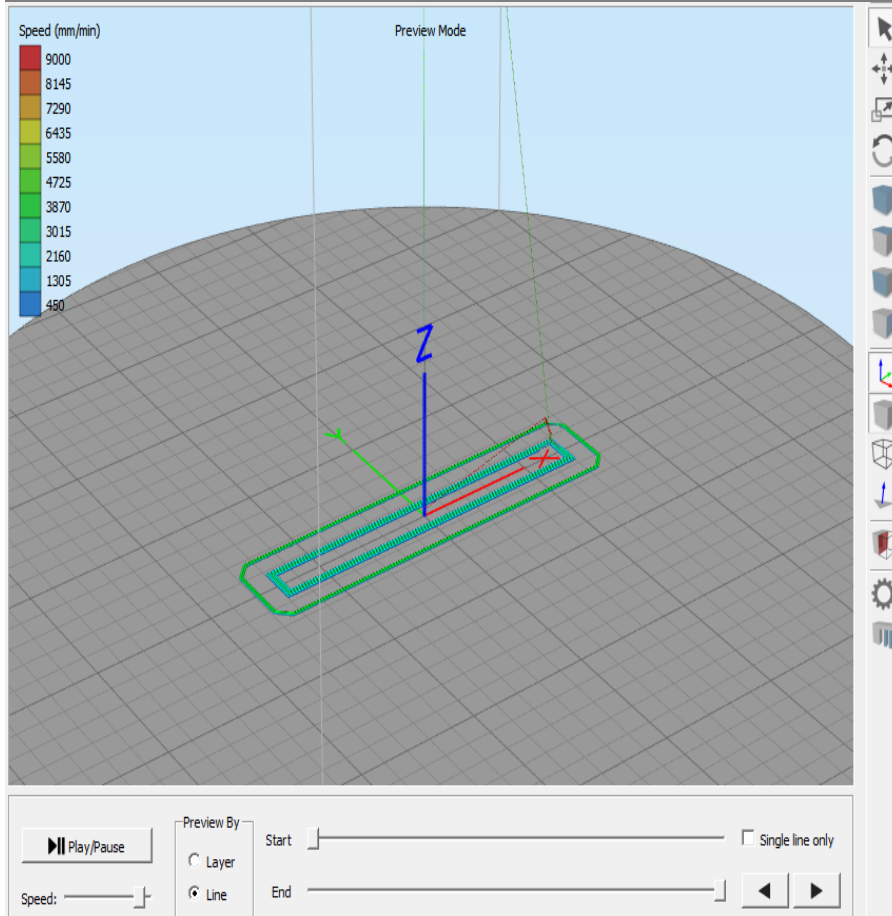
Design/CAD

Product

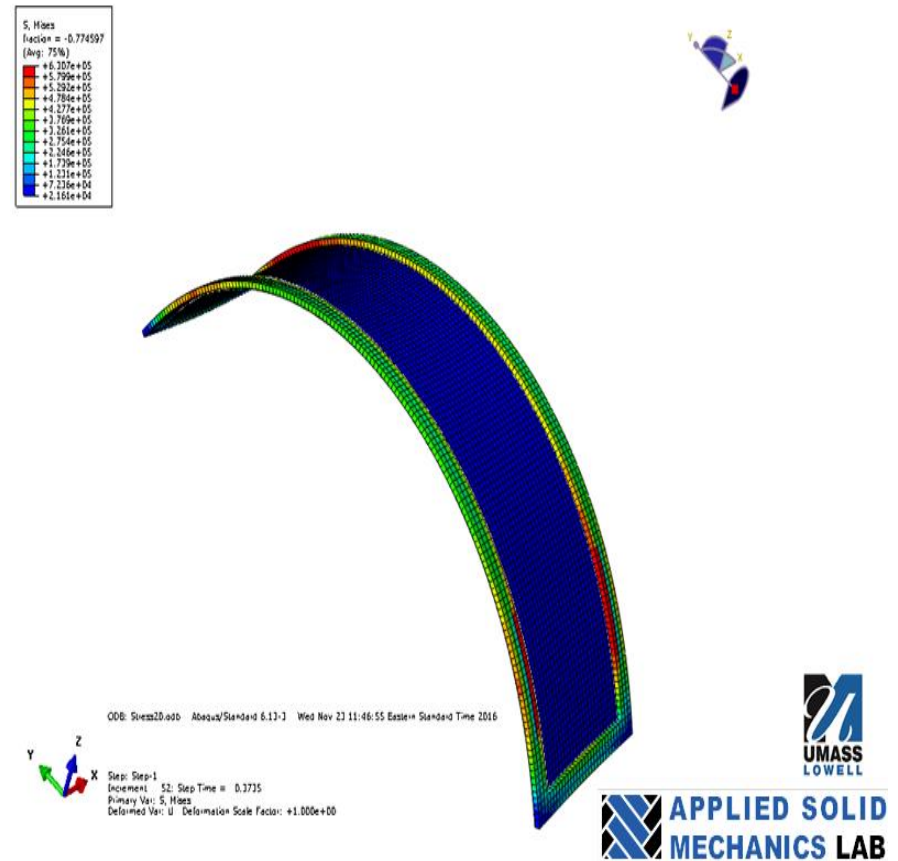


4D Textiles – Simulation

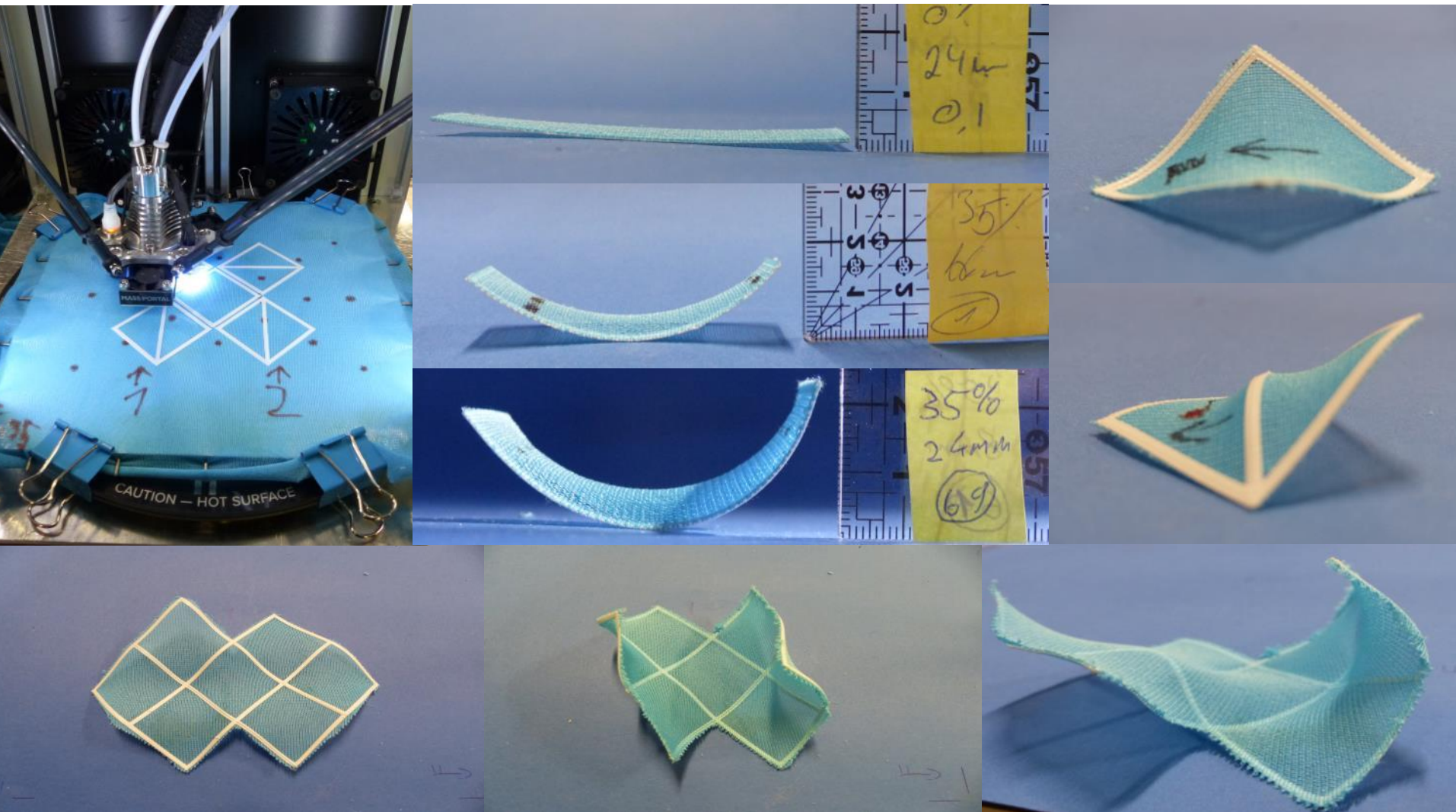
Slicing



Simulation



4D Textiles – Trials/Validation



4D Textiles – CAD/Design

CAD

mit.edu

MIT Google People Offices

MIT Technology | Monday, December 22, 2014

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today's spotlight
Curves ahead
3-D-printable materials deform to change surface area, enabling curvature rather than rigid folding

news
Virtual vortexes within specialized crystals confer ability to halt photons
Study: Industrial clusters fuel economies
New computer network rivals the primate brain in object recognition
Rhodes Scholar Anisha Gururaj connects life-changing technology to people in need

research | campus | press

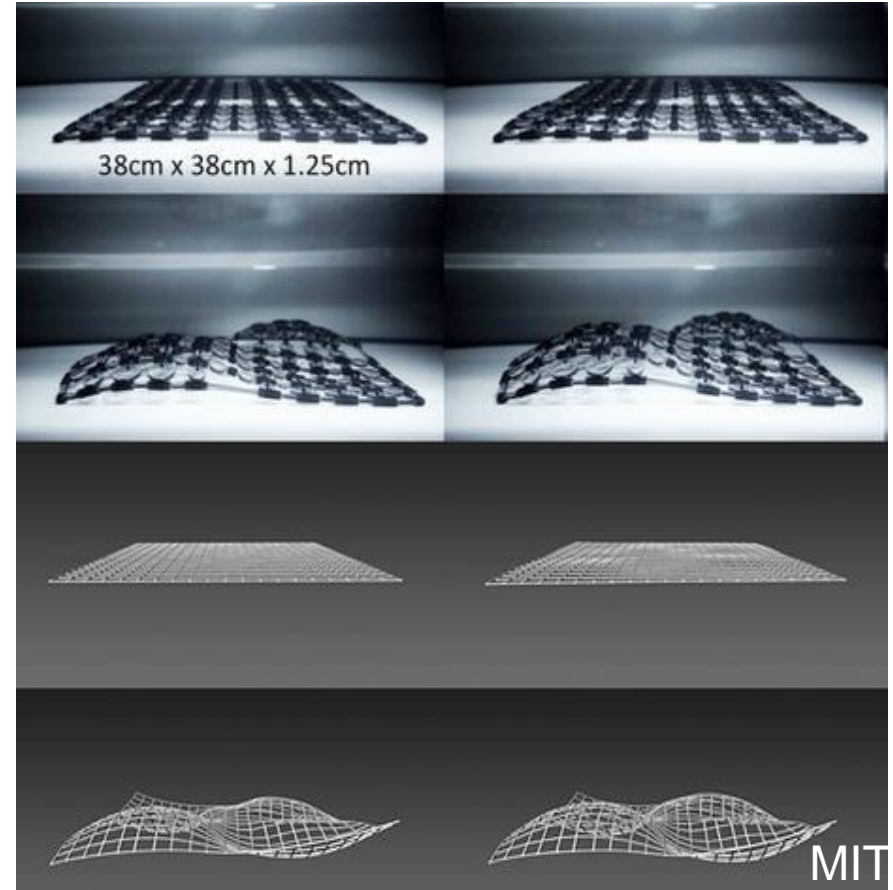
events
Register: IAP Fitness and Wellness programs
Exhibition: Thea Djordjadze
Domain walls and vortices dynamics for spintronics (Dec. 22)

Today's image

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Design

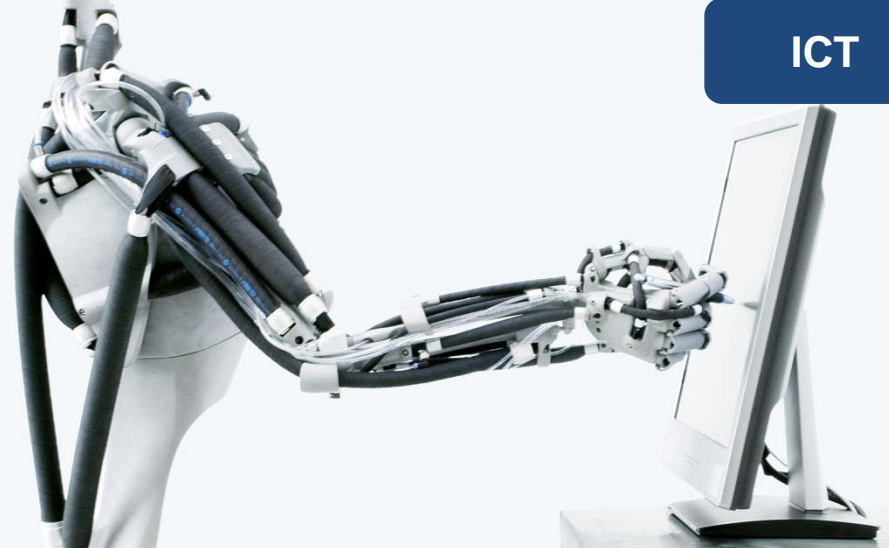


4D Textiles – Applications

Health



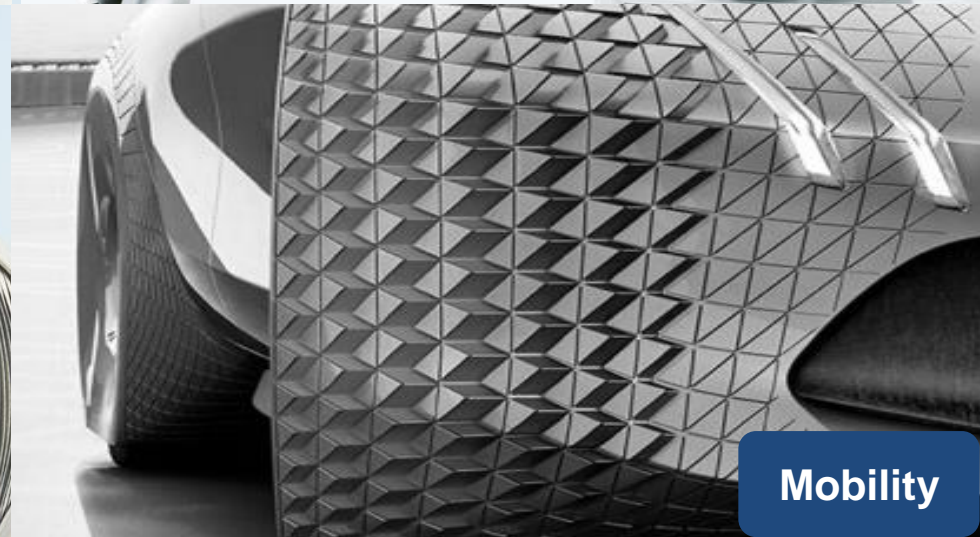
ICT



Building



Mobility



Health



Today

- Handcrafted stents
- Mechanical assembly
- Self expandable structures

Tomorrow

- Self assembled stents
- Individual self evolving structures
- Intelligent blood pump

Approach

- Smart active biocompatible yarn materials
- Digital individualized braiding of yarn material
- Tissue engineering on 4D textile structures

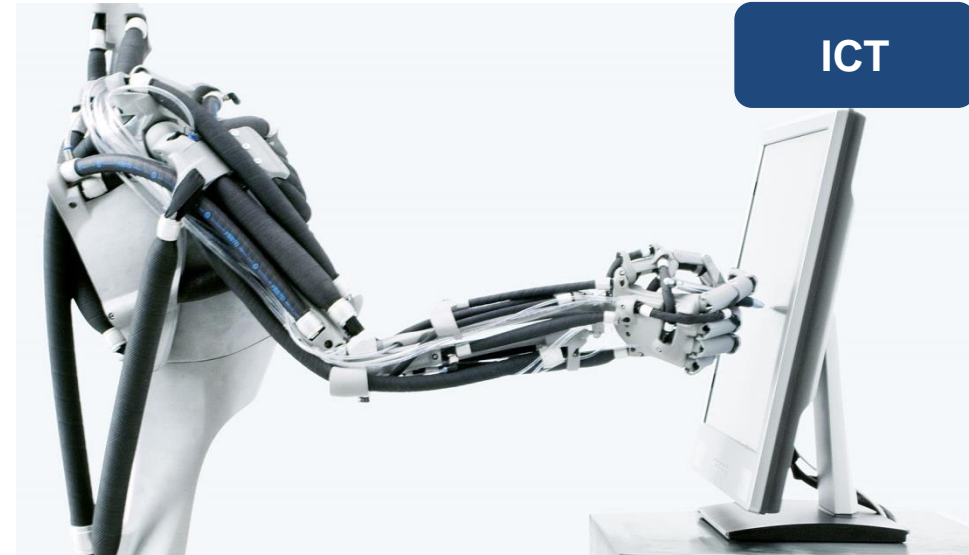
4D Textiles – Applications

Today

- Static robot systems
- Predefined work situations
- No active interaction with the environment

Tomorrow

- Artificial intelligence
- Autonomous machines
- Self evolving structures
- Self assembly of robots



Approach

- Bionic muscle structures
- Active human-machine interaction by self learning textile
- Structural integrated motion control

4D Textiles – Applications

Today

- Glass fronts
- Light transmitting concrete
- Lightweight textile concrete

Tomorrow

- Bionic in- & outdoor components
- Interactive façade
- Intelligent response to outdoor conditions
- Self building elements



Building

Approach

- 4D warp knitted structures
- Elastic concrete for outdoor applications
- Bionic design rules

4D Textiles – Applications

Today

- Lightweight bodywork
- Carbon fiber reinforced structures
- Passive aerodynamic
- Line-shaped design

Approach

- Hyper-elastic textiles functionalized by 4D printing
- Sensor systems for self evolving structures
- Design rules for 4D textile elements

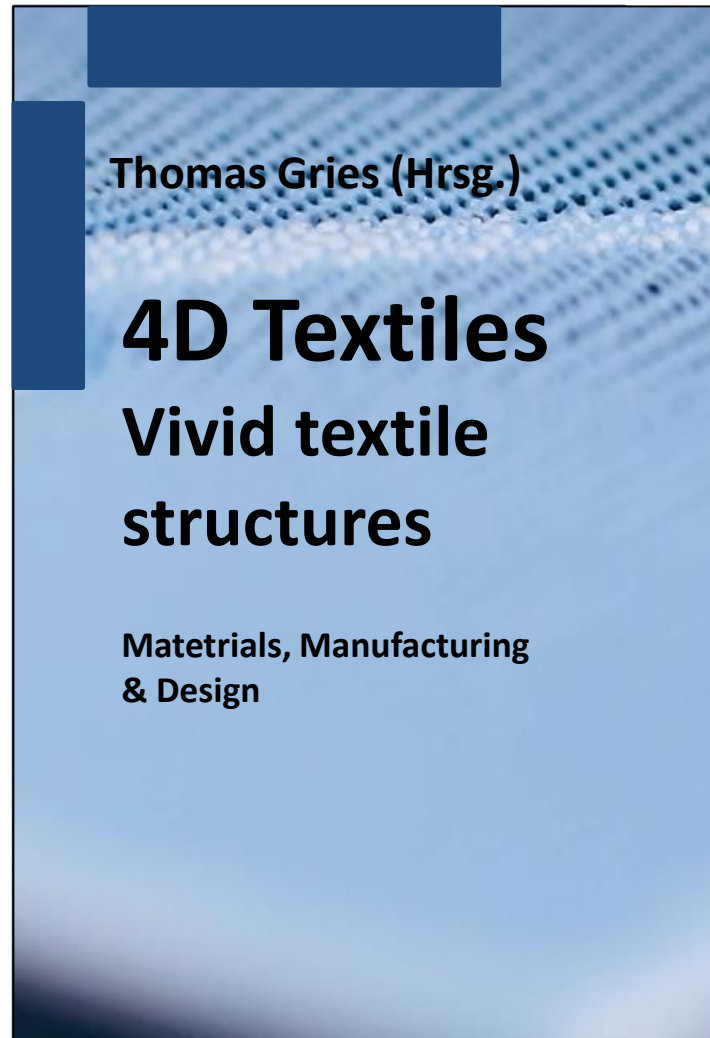
Tomorrow

- Self expanding bodywork
- No structural parts needed
- Intelligent safety by shape change
- Active aerodynamic



4D Textiles - Book

**Coming up:
Summer 2017**



4D Textiles - Conference



1st 4D Textiles Conference

in June 2017



Digital Products – Dream2Lab2Fab



Textile Learning Factory „Digital Products and Production“

Product



Smart,
customizable
wristband

Machines

- 1 Warping creel
- 2 Warping machine
- 3 Weaving machine
- 4 Light table
- 5 Coating & thermo-setting device
- 6 Inkjet printer
- 7 Cutting machine
- 8 Sewing machine
- 9 Testing station



i4

The Institute

4D

Future Textiles

**Thank
you**

4

**your
attention**