https://www.healthtech.kit.edu

Karlsruhe Institute of Technology

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About us **Research** **KARE** **Education** **Innovation and Partners** **Platforms** **News & Events**

KITHealthTech

KIT Center of Health Technologies

KARE

The vision of KITHealthTech is to create a unique interaction with patients and citizens, physicians and clinics →

Thematic Fields

To enable and accelerate cutting edge research in Health Technologies, KITHealthTech will focus on three main overarching Thematic Fields →

Research Fields

12 Main Research Topics of KITHealthTech →

Focus Fields

Focus Fields are dynamic structures giving the FOCUS to highly relevant scientific challenges →

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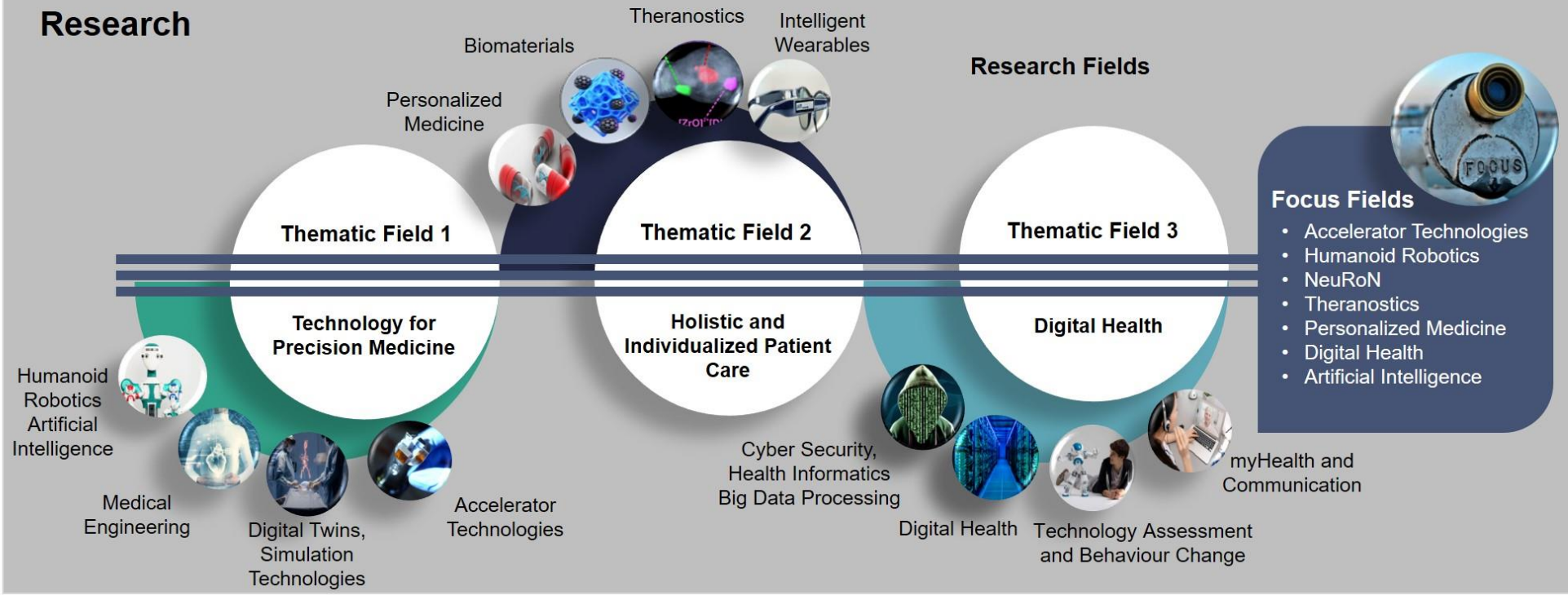
KITHealthTech

KIT Center of Health Technologies

Karlsruher Region of Health Technologies

Research



Transfer & Innovation

- Interaction with Society
- Engagement with Healthcare Providers
- IP Generation
- Industrial Collaboration
- Industrial Partnerships
- Spin-offs

Teaching

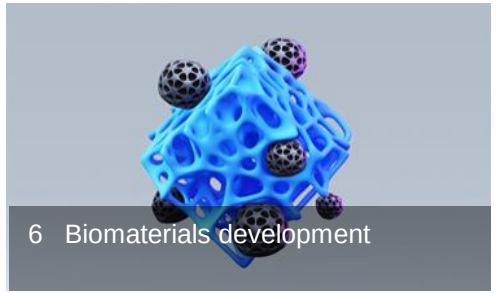
Study Program
Medical Technology

- Bachelor and Master Programs
- Specialization for Other Study Programs
- Graduate Schools
- upCAT Accelerator

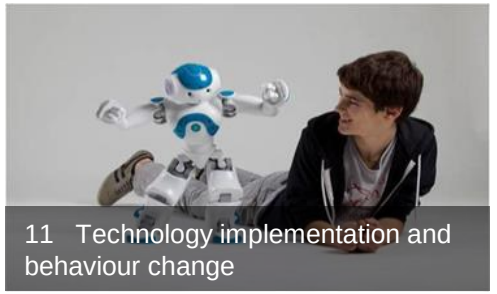
Research Fields

P3

P3



P1/P3



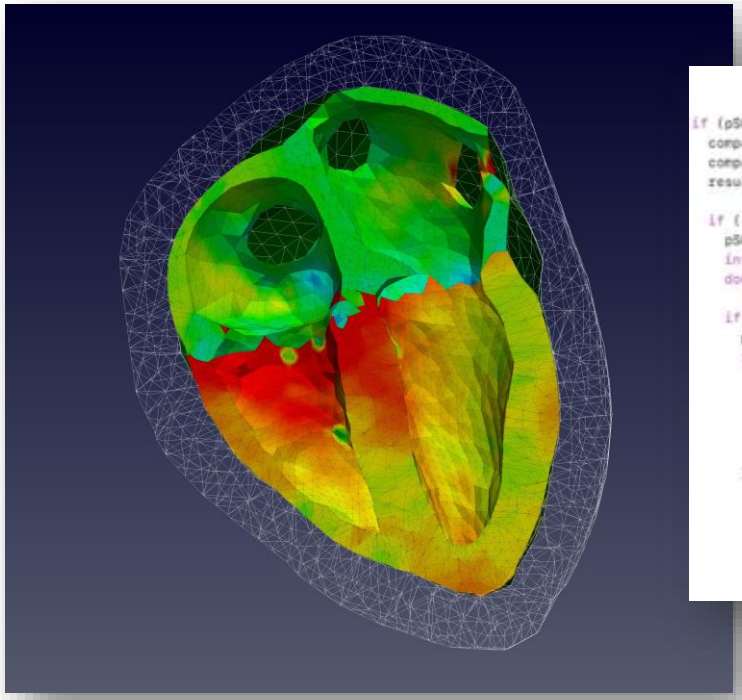
Thematic Field 1: Digital Twin & Simulations Technology

Computational Models of the Heart

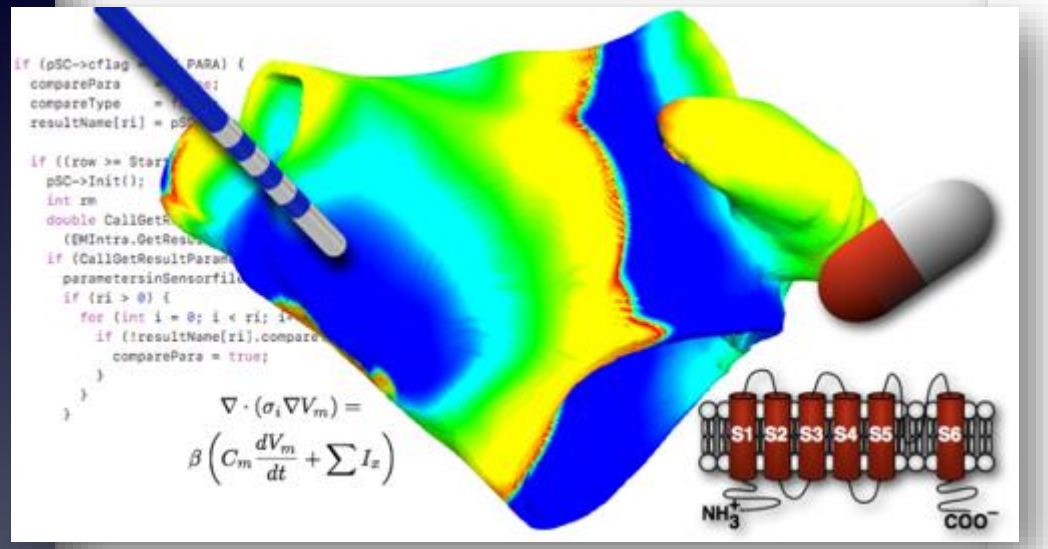
- Modelling of the electrophysiology and mechanics of the heart
- Integration from ion channels via cells to tissues and organs

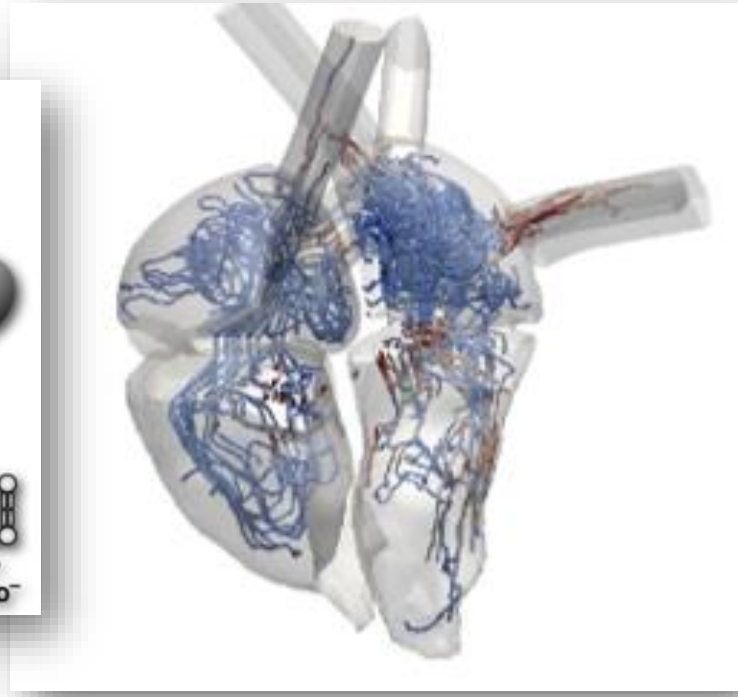
Numerical Simulations of the Heart

- Numerical Simulations of Hemodynamics in the Human Heart (CFD)
- Possible extension towards air flow in breathing/nasal air flow



@ A. Loewe (KIT)



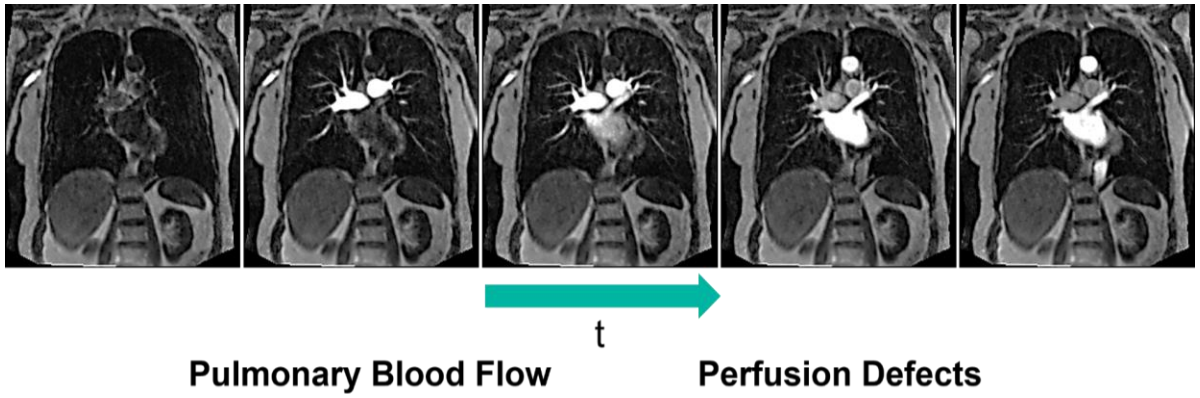


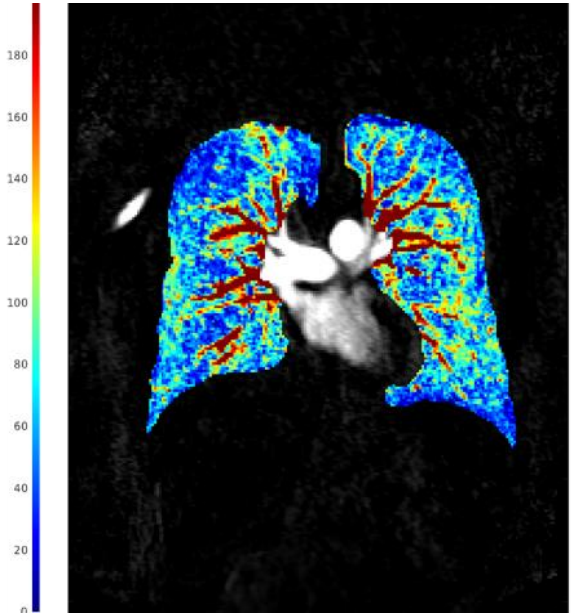
@ B. Frohnapfel (KIT)

Thematic Field 1/2: Simulations & Biomaterials

Quantifying lung perfusion parameters

- Dynamic contrast enhanced MRI (DCE-MRI) of the lung
- Quantification the perfusion parameters and abnormalities based on mathematical methods





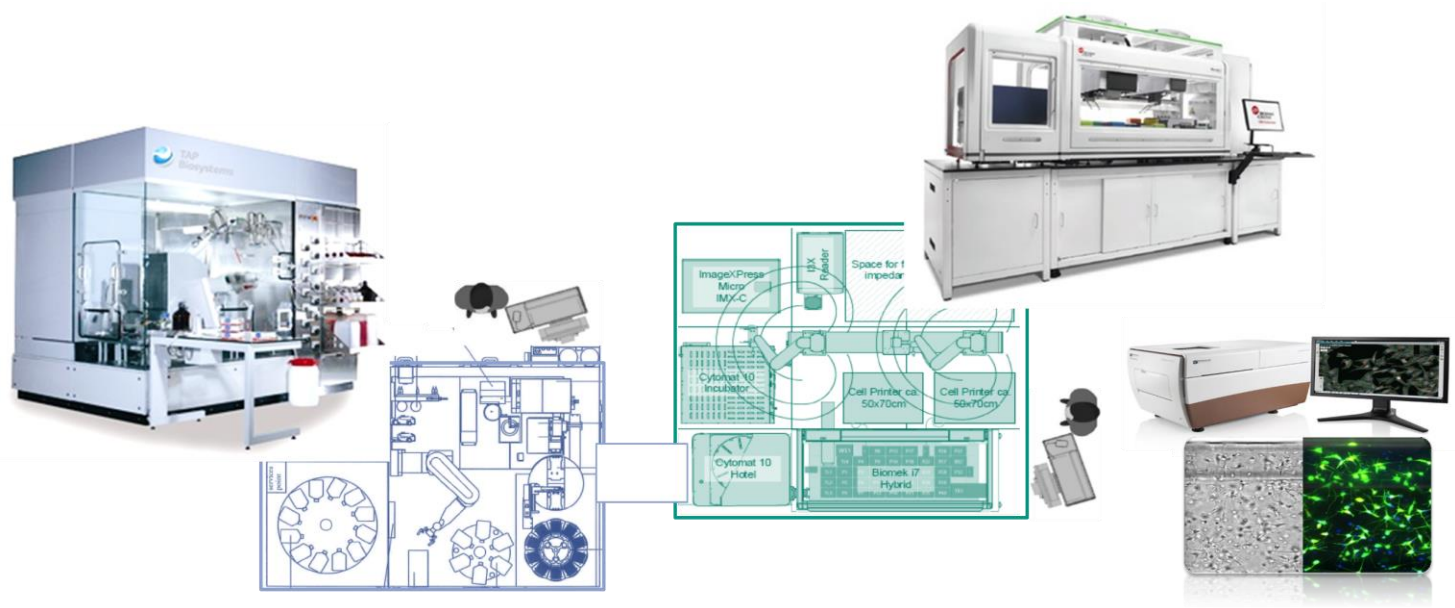
@ B. Nestler, A. Koeppe (KIT)

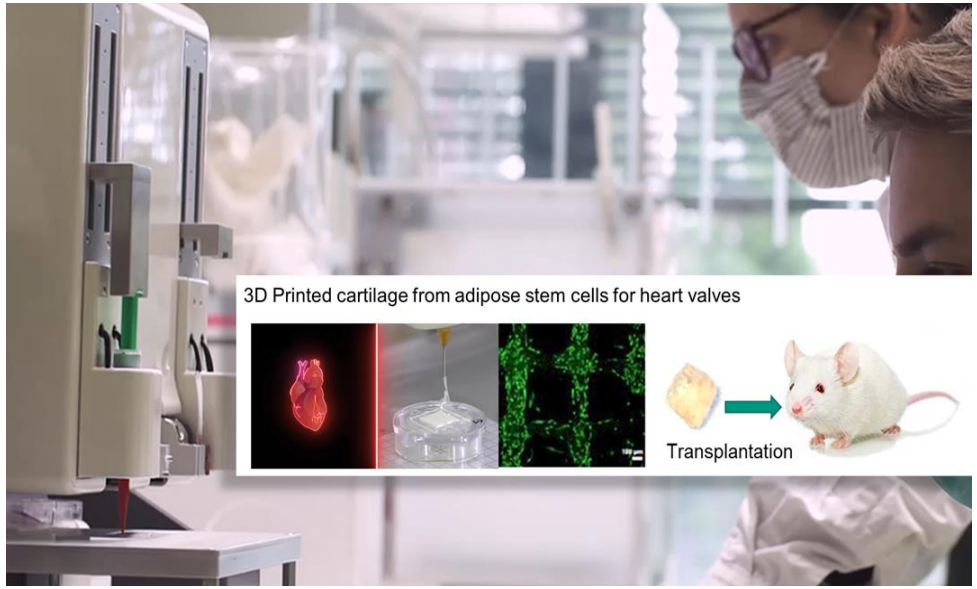
Kadi4Mat

Thematic Field 2: Biomaterials

BioMAT Foundry

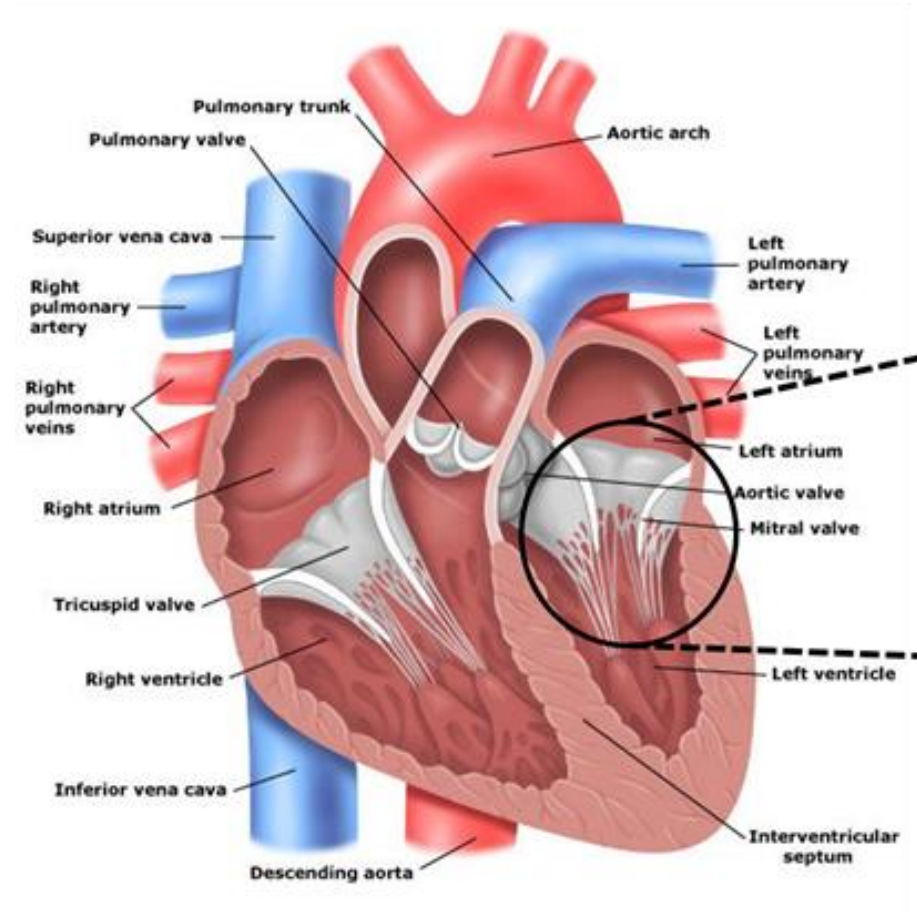
- 3D bioprinting automation, fully autonomous bioprinting and materials development pipeline
- hybrid biomaterials for pharmaceuticals, regenerative medicine, and biotechnology
- Implant materials

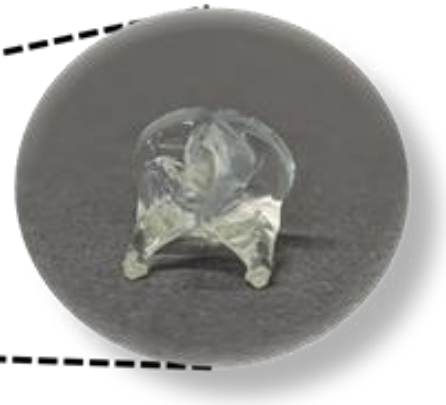




@ U. Schepers, J. Hubbuch, M. Franzreb, S. Bräse, W.Wenzel, J. Aghassi, M. Wegener, C. Wöll, S. Dehnen (KIT)

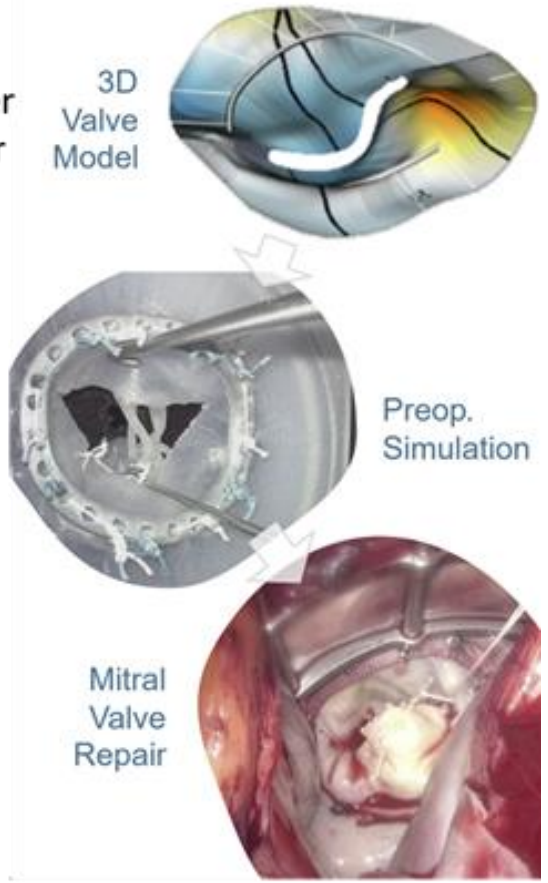
Thematic Field 2: Biomaterials





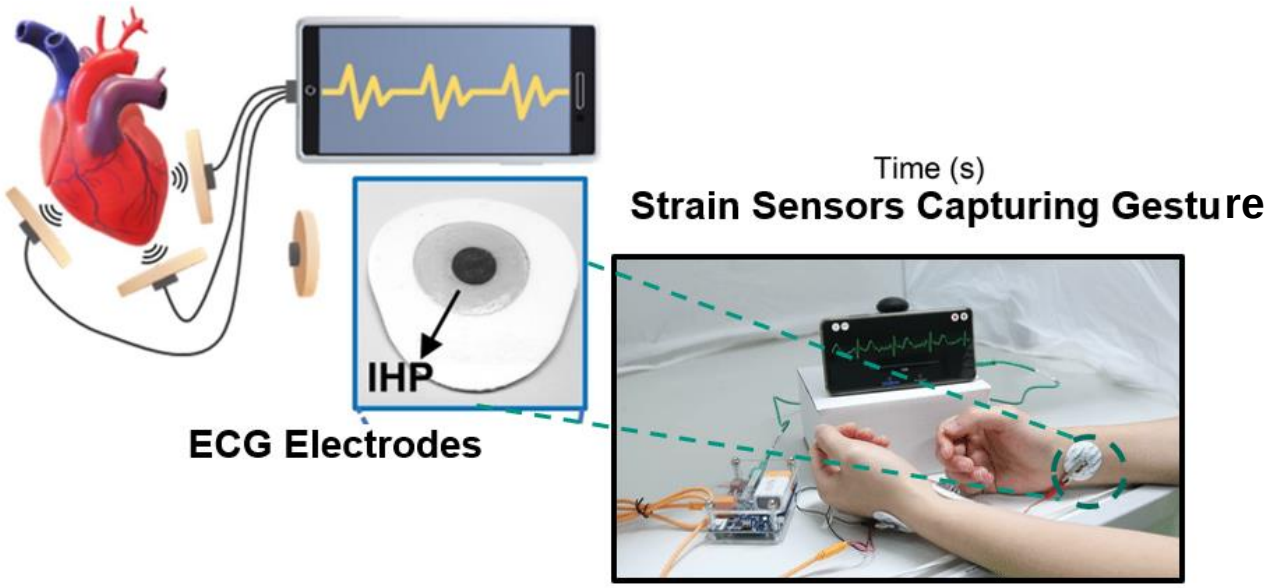
3D Bioprinting of the mitral valve

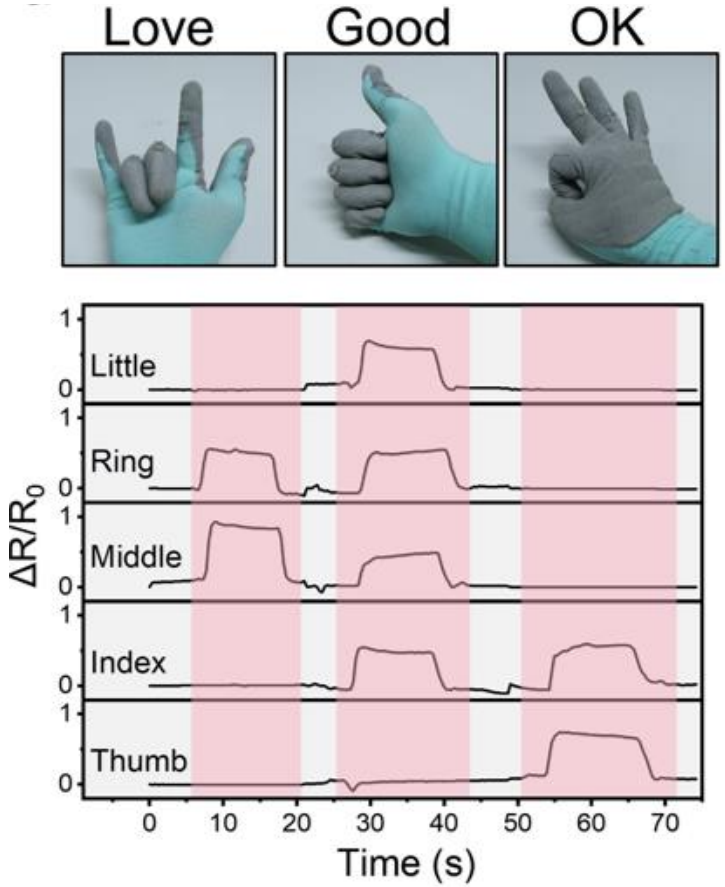
Surgery trainer and simulator



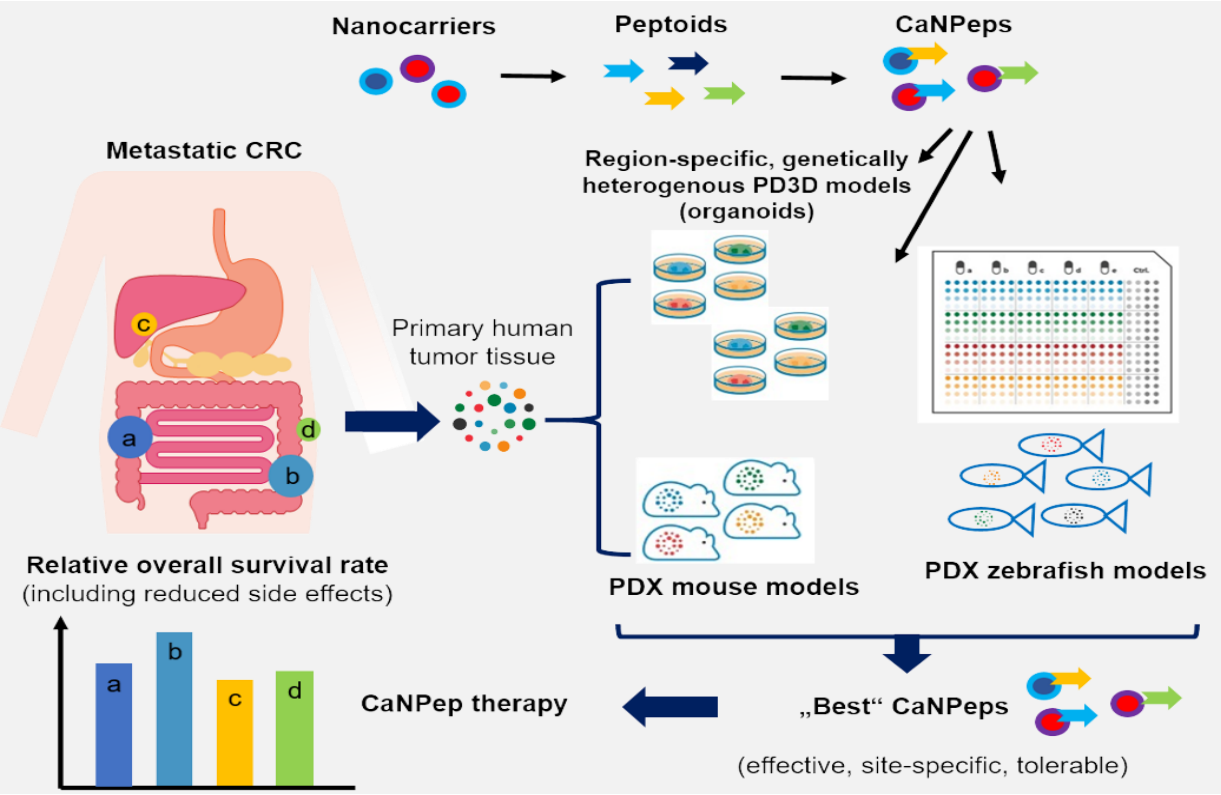
Developing soft materials with novel properties

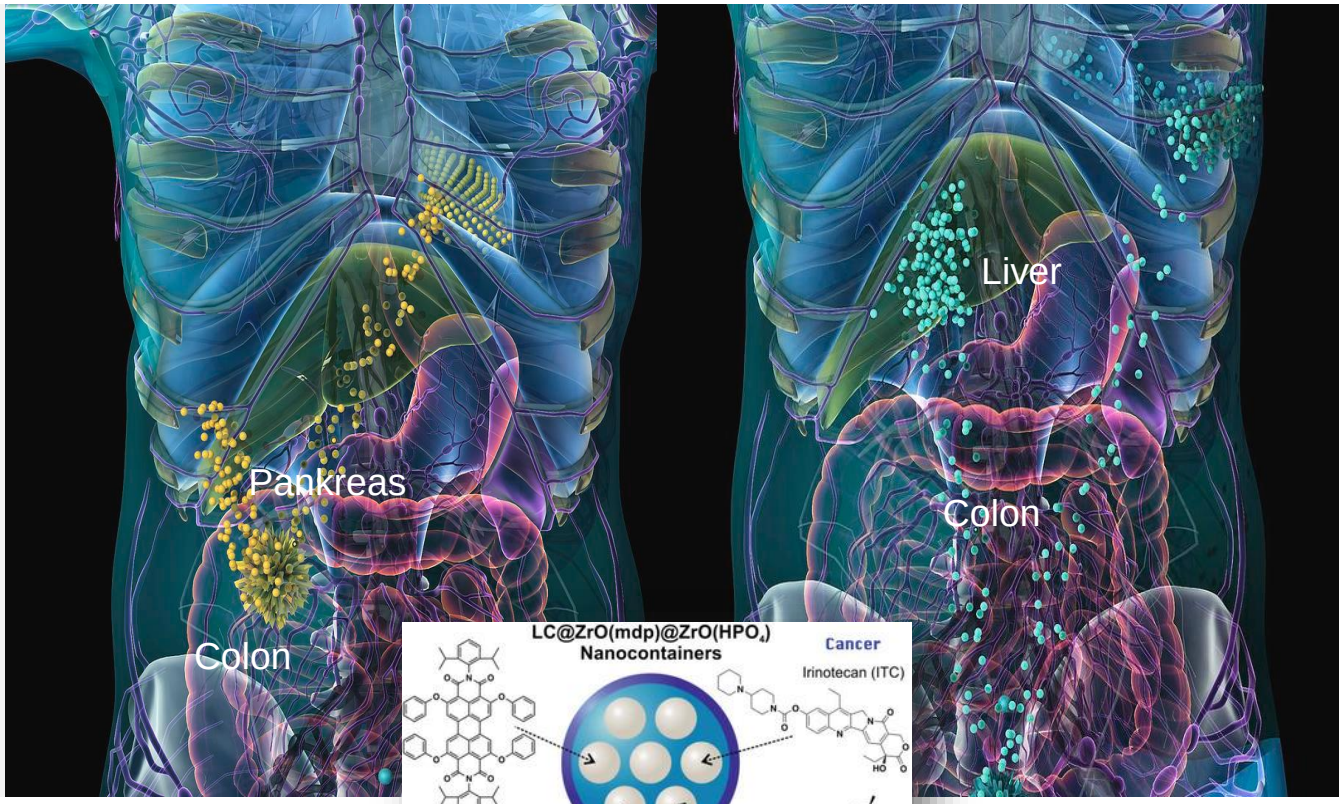
Soft Materials for Precise and Long-term Health Monitor





Thematic Field 2: Theranostics



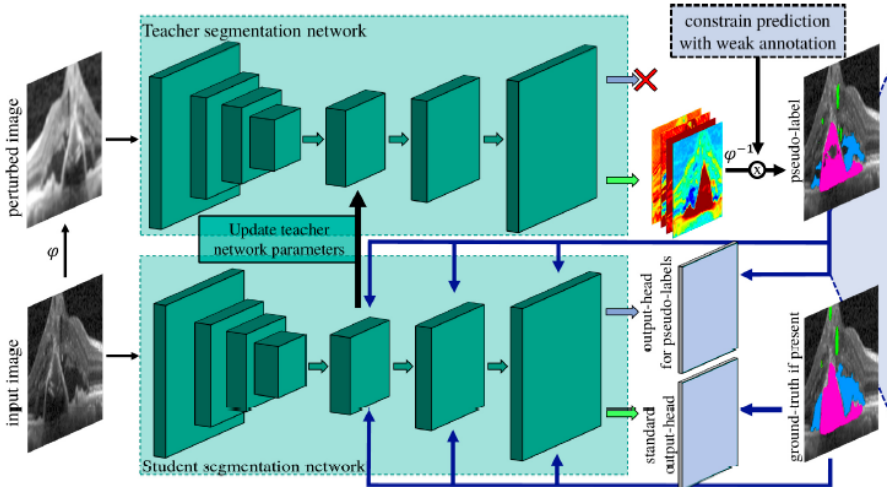


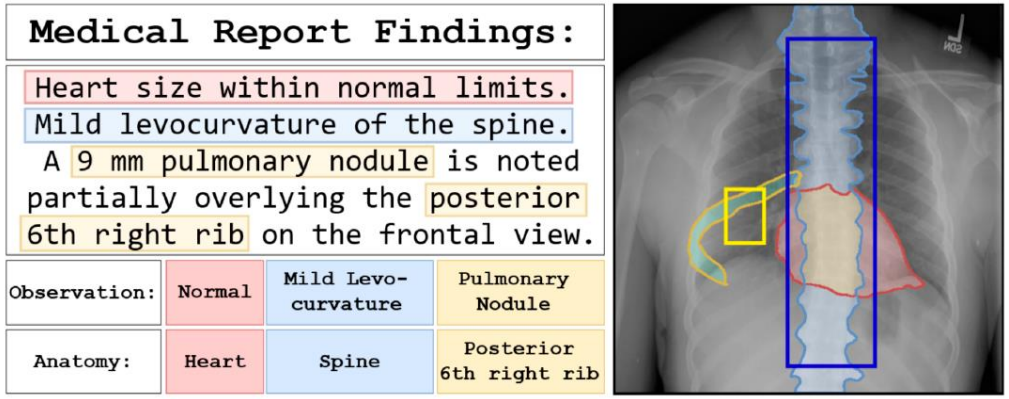
@ C. Feldmann, Orian-Rousseau, Schepers (KIT)

Thematic Field : Cyber Security, Health Informatics, Big Data Processing

Weakly and noisy health data

- Machine learning methods with little or weakly annotated data
- Exploring methods for modeling the uncertainty of learned (deep learning) models





@R. Stiefelhagen (KIT)

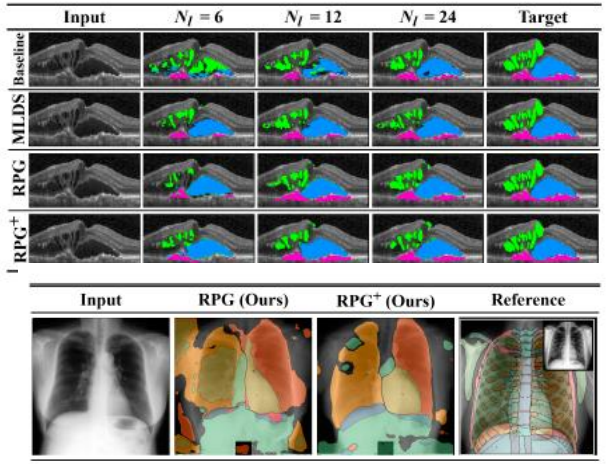


Figure 4: Qualitative Segmentation Results on extended anatomical x-ray annotations.

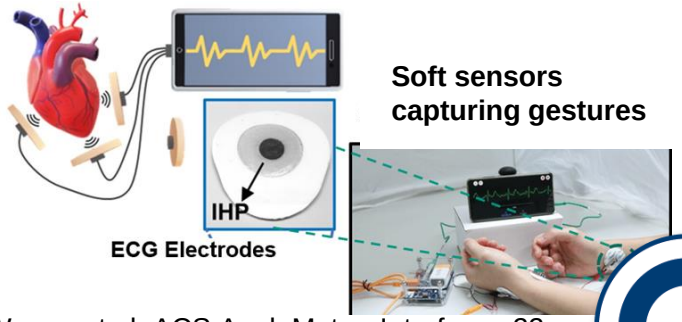
Towards a Digital Twin (Patient) at KIT: Biomaterials design for heart tissue replacements

Karlsruher Institut für Technologie

Experiments

Simulation and Digital Twin

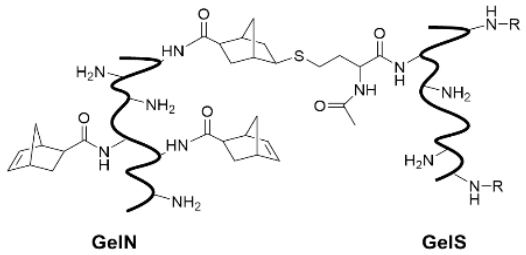
Soft materials for sensors



Soft sensors capturing gestures

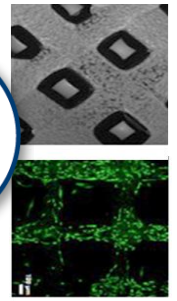
Wang et al. ACS Appl. Mater. Interfaces 22

Autonomous Materials Development



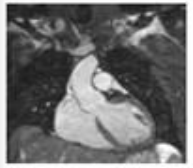
Göckler et al. Adv. Healthcare Mater.2019

3D Bioprinting of heart tissue



Burchak et al. Int J Mol Sci, 2022

Geometrical Model

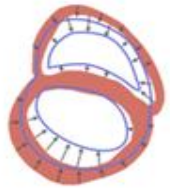


4D Cine MRI Data

CardioMechanics

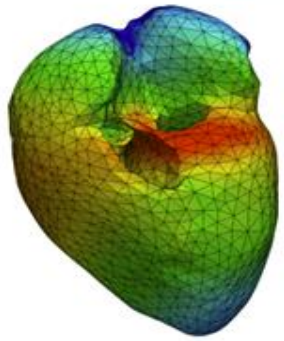
Simulation & Parameter Estimation Framework

- Coupled with Electrophysiological Model of the Heart for ActiveTension Development
- Nonlinear Continuum Mechanics $\mathbf{u}(X) = \mathbf{u}_I N_I(\mathbf{X})$
- Finite Element Analysis
- Circulatory System Model
- Parameter Optimization Algorithms

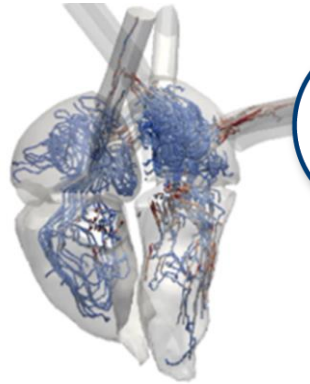


Personalized Biomechnical Simulation

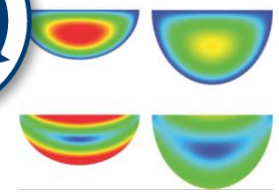
Diagnosis / Prognosis
Intervention Planning



Numerical Simulations of Hemodynamics



Simulations of Hemodynamics



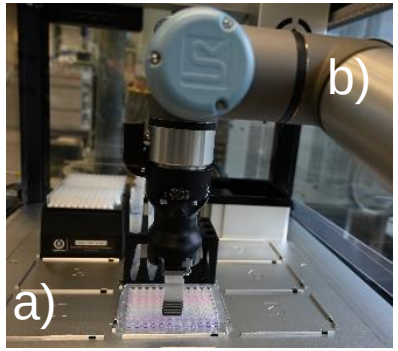
Kappings et al. Adv. Mater. Technol. 2018

Towards Digital Bioprocess Twins at KIT: Bioadsorbents for biopharmaceutical applications

Karlsruher Institut für Technologie

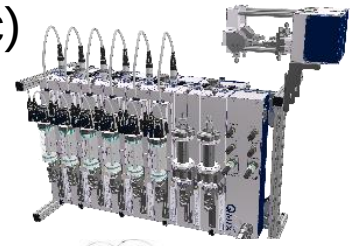
Experiments

Automated high throughput screening



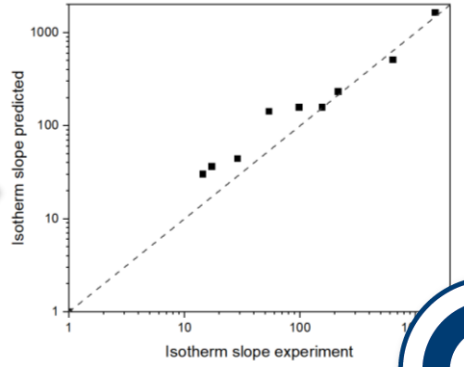
Automated laboratory
Including:
- Liquid handling station (a))
- Robotic arm for plate transfer (b))
- High-pressure precision pumps (c),d))
- Detectors e.g. plate reader
- Vacuum manifold for sample collection

c)



d)

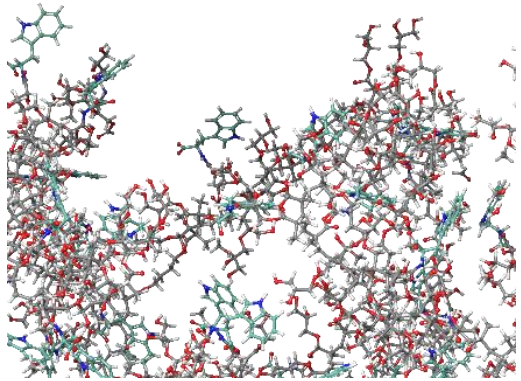
Prediction of experimentally determined data



- Training of models with trainings-sets
- Predict experimental data using test-sets

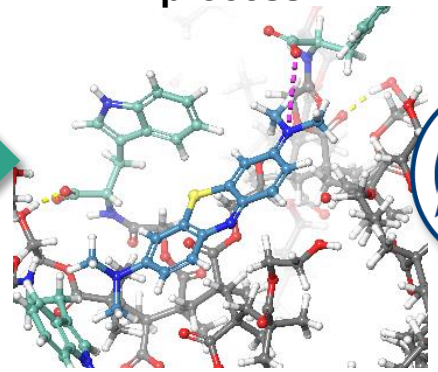
Simulation and Digital Twin

Virtual materials design



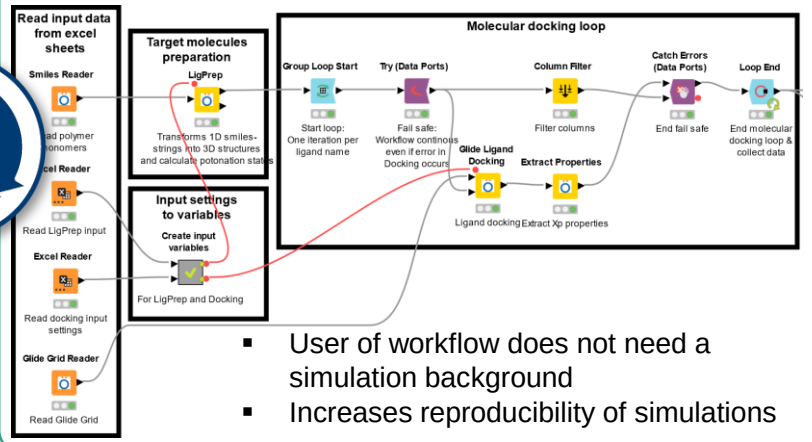
- Digital twin of a chromatography resin
- All-atom resolution

Simulation of adsorption process



- Adsorption of dye molecules
- Calculation of binding energies

Automatization of simulations with workflow technology



- User of workflow does not need a simulation background
- Increases reproducibility of simulations

JOINT LAB VIRTUAL MATERIALS DESIGN

Research Platforms

3ROCKIT

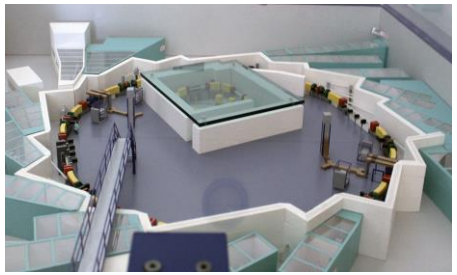
KD²lab

HoreKa

SDIL

KNMFi

KCOP



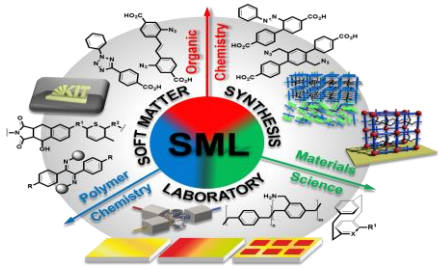
Accelerator Platform

Innovation Lab

SSPE

SDSC-BW

COMPLAT



Soft Matter Lab

Research Platforms

3ROCKIT

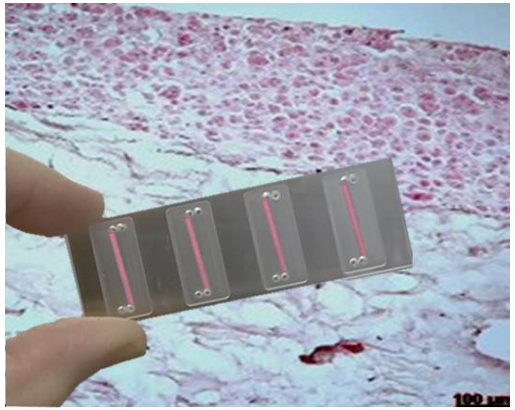
3ROCKIT stands for **R**eplace **R**educe **R**efine **O**rganismal **R**esearch by **C**omputational and **C**ellular technologies@KIT. Research groups at KIT develop novel *in vitro* and *in silico* technologies to ultimately replace animal studies and methods for automated and intelligent surgical assistance and for future autonomous interventions.

Today, the enourmous development in the health technologies sector would not be possible without interventions and tests in living organisms. To analyze the effects of novel technologies, drugs and implants inside the body in health and disease and to transfer this knowledge into the clinic, conducting research on living organisms is therefore still indispensable. Today, the 3Rs, **R**educing, **R**eplacing and **R**efining the animal research, are reflecting the awareness and responsibility of scientists and society towards a more ethical use of animals in product testing and scientific research. At KIT we have strongly committed ourselves to the 3R principles by using non-animal research wherever it is possible and by encouraging technology development of alternative methods. In the last years we set up a Research Field on “Lifescience engineering” with a strong focus on *in vitro* and especially on *in silico* alternatives to animal testings.

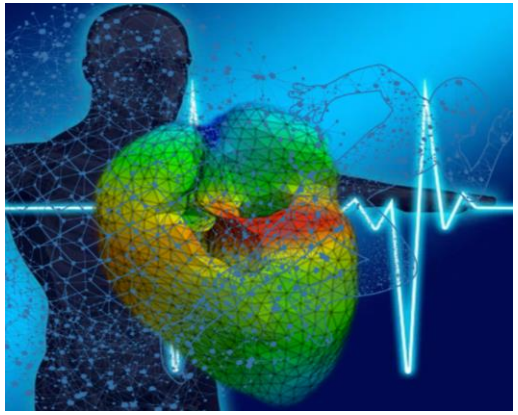
3RockIT Core Units

Preclinical Research Center

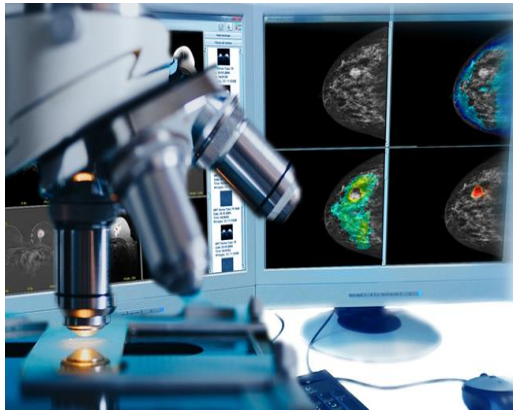
BioBanK



Tissue Engineering Center



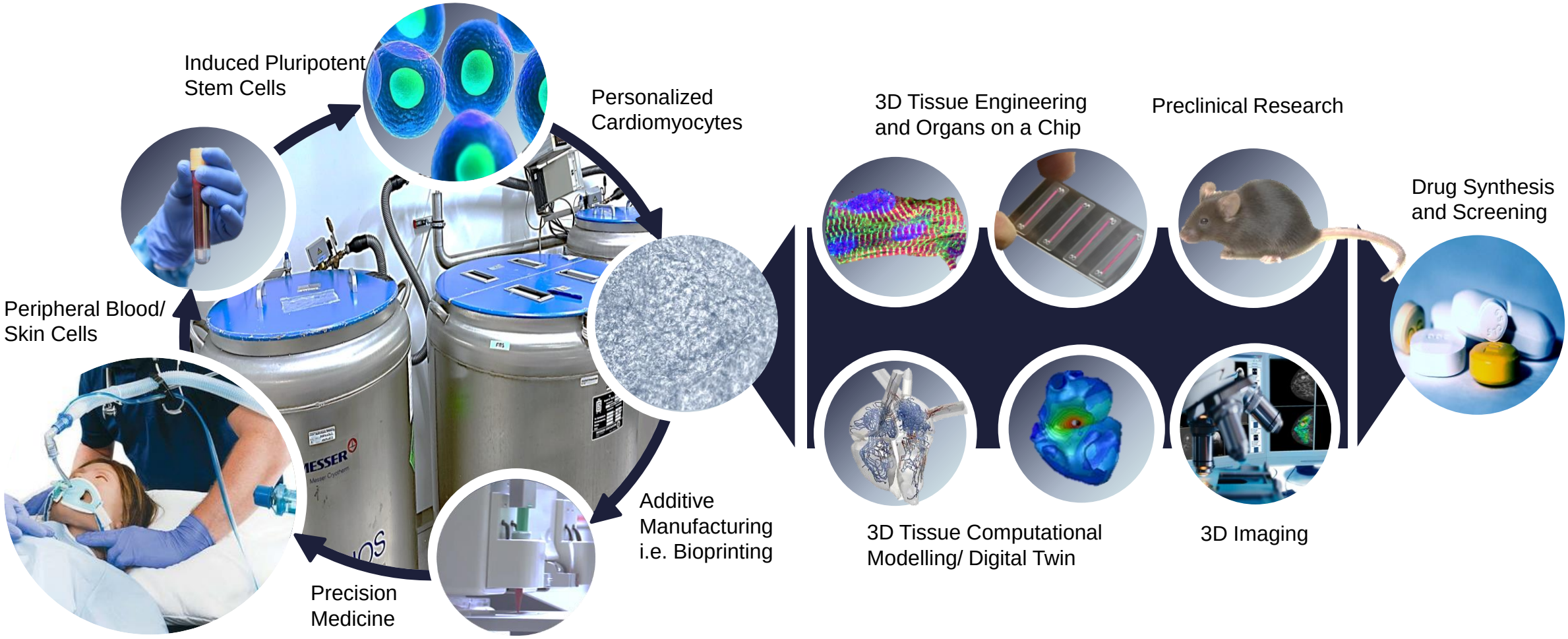
Center of Computational Tissues



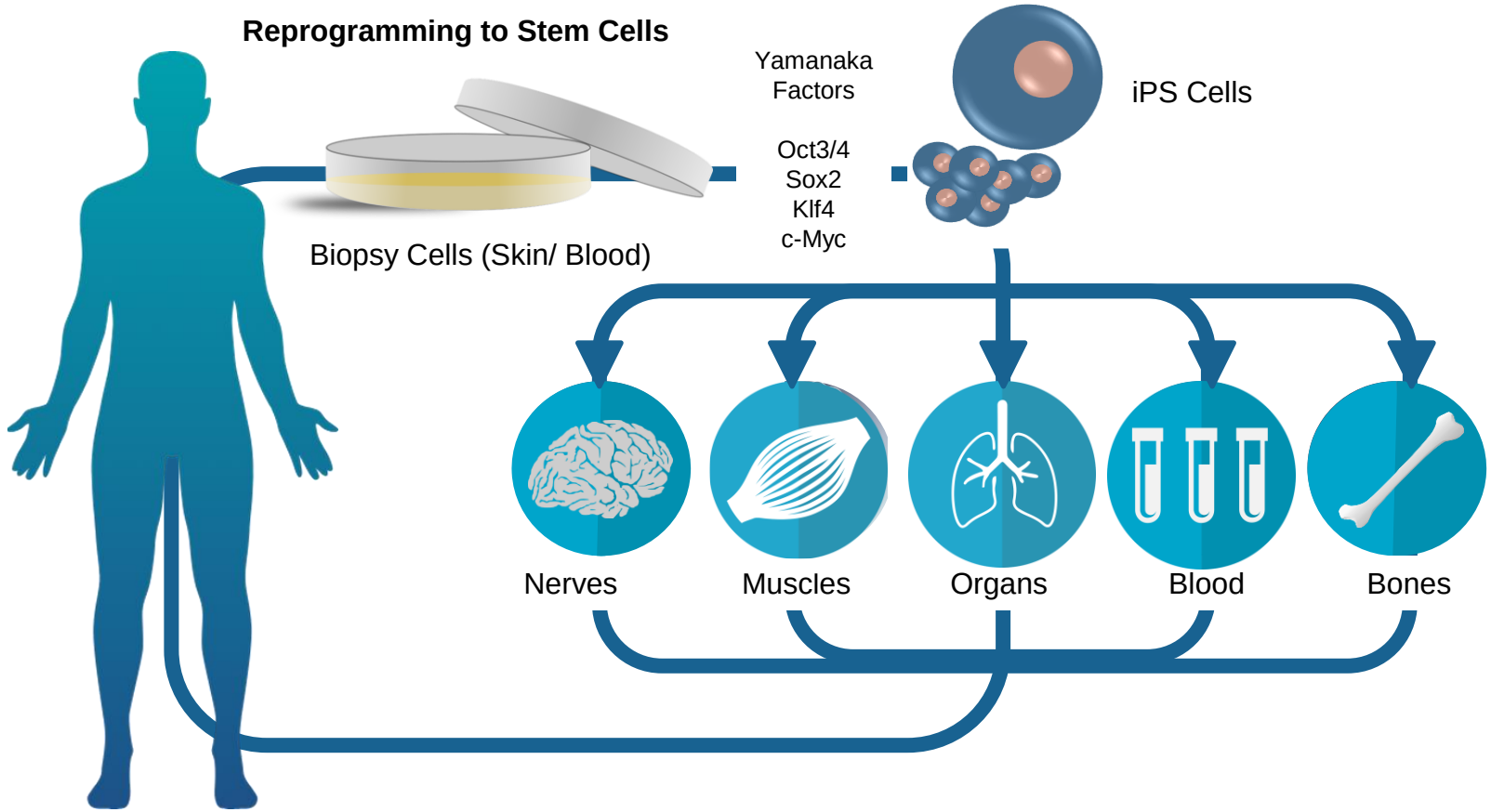
Tissue Imaging Core

3D-Printing Center

3ROCKIT: Vision and Concept



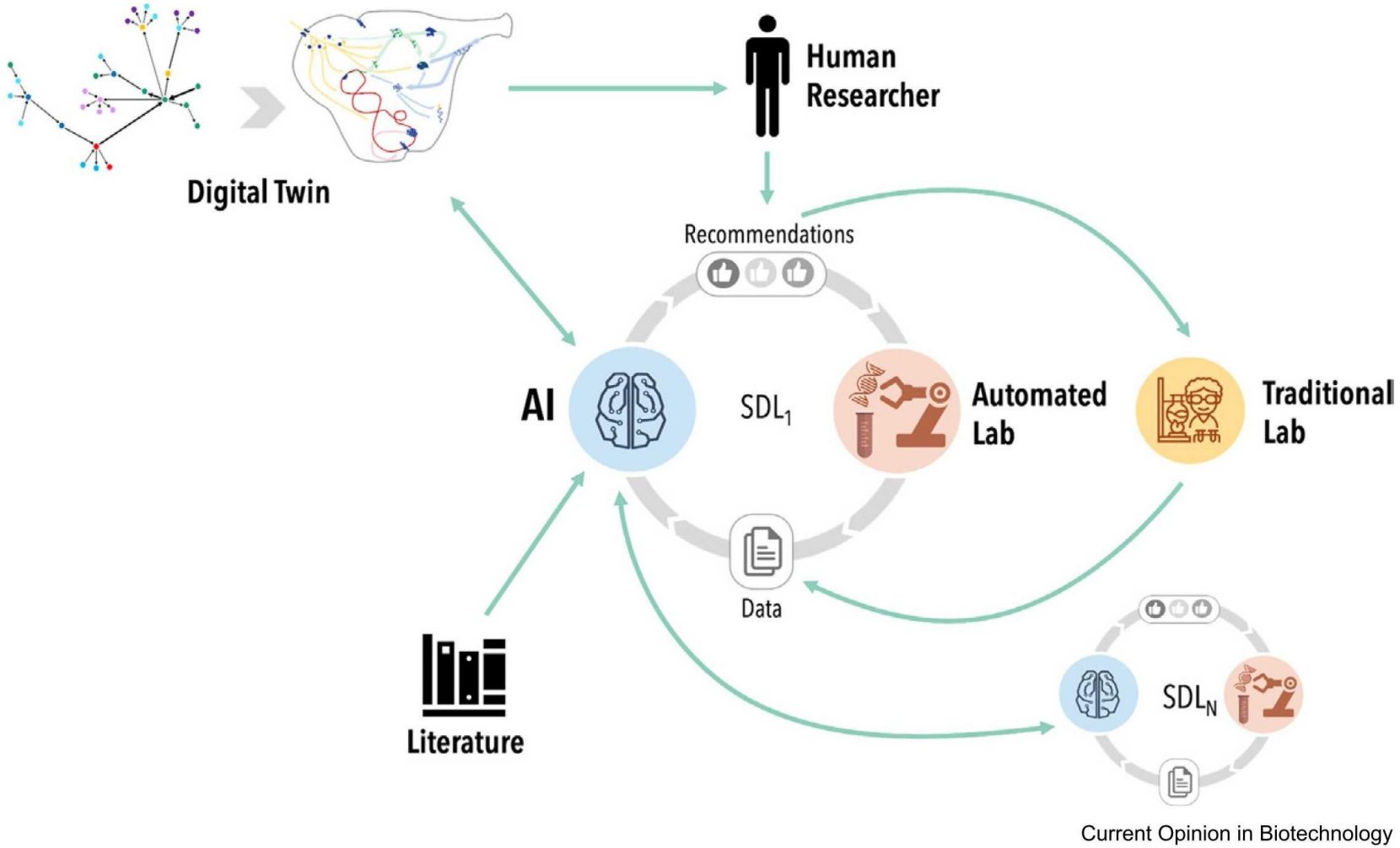
3ROCKIT : BioBanK



Storage at BioBanK

From Shinya Yamanaka, The Nobel Prize in Physiology or Medicine 2012

Platforms: Self driving labs for biomaterials development

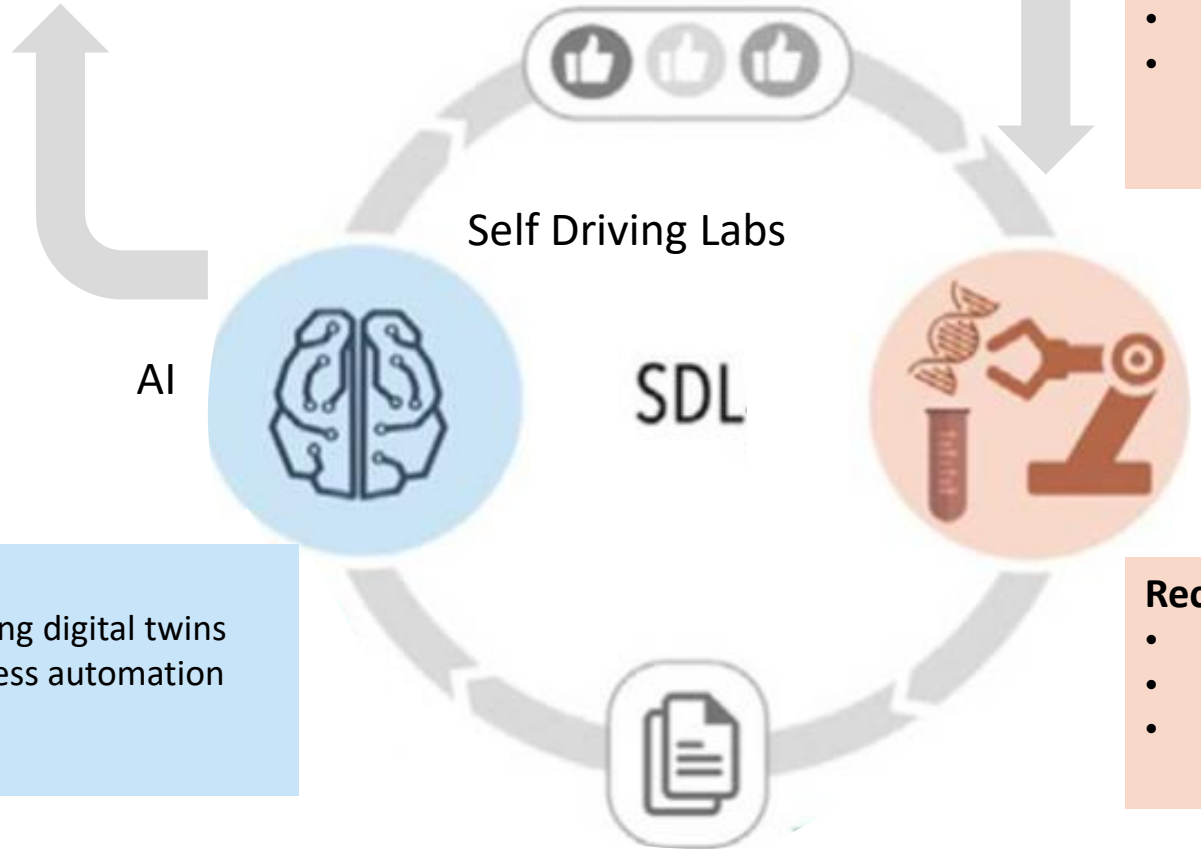


Current Opinion in Biotechnology

Cell Factories
- Microbiomes of extremophile micororganisms as model
- organisms
- Artificial organisms/ biohybrid technologies

Center for Synthetic Genomics
- Synthetic Biology
- Artificial „synthetic“ genomes
- Genome edting
- Self-reproducing structures
- Artificial organisms

Understanding Biology
- Fully automated culture of cells, organoids, 3D tissues
- 3D Imaging Platform
- Genomics and Spatial Transcriptomics Platform
- Proteomics, Metabolomics and Interactomics



Manipulating Biology (Chem.ASAP)
- High throughput synthesis and screening
- Digital twins of novel biologically relevant molecules
- Synthesis, Characterization & functional analysis

BiologAI
- AI Methods for building digital twins
- AI methods and process automation
- Data Interoperability
- Data compatibility

Reconstructing Biology (Bio.Mat Foundry)
- (Bio)materials acceleration platform
- Additive Manufacturing, processes development
- Digital twins of novel bioinstructive bioadaptive materials systems

Bioengineering Data
- ELN/repositories/RDM
- Machine learning models
- VirtMat

Engineering Biology
CIW,BIW, BIO.CAR
- Fabrication/scale-up processes

https://www.healthtech.kit.edu

KITHealthTech

KIT Center of Health Technologies

Climate & Environment
Mobility & Health
Urban Living
Food

New!
City Health

Nutrition
Climate & Environment
Urban Living
Mobility

Karlsruher Region of Health Technologies

Research

Biomaterials
Theranostics
Intelligent Wearables
Personalized Medicine

Thematic Field 1
Technology for Precision Medicine

Thematic Field 2
Holistic and Individualized Patient Care

Thematic Field 3
Digital Health

Research Fields

Focus Fields
- Accelerator Technologies
- Humanoid Robotics
- NeuRoN
- Theranostics
- Personalized Medicine
- Digital Health
- Artificial Intelligence

Humanoid Robotics Artificial Intelligence
Medical Engineering
Digital Twins, Simulation Technologies
Accelerator Technologies
Cyber Security, Health Informatics Big Data Processing
Digital Health
Technology Assessment and Behaviour Change
myHealth and Communication

Transfer & Innovation

- Interaction with Society
- Engagement with Healthcare Providers
- IP Generation
- Industrial Collaboration
- Industrial Partnerships
- Spin-offs

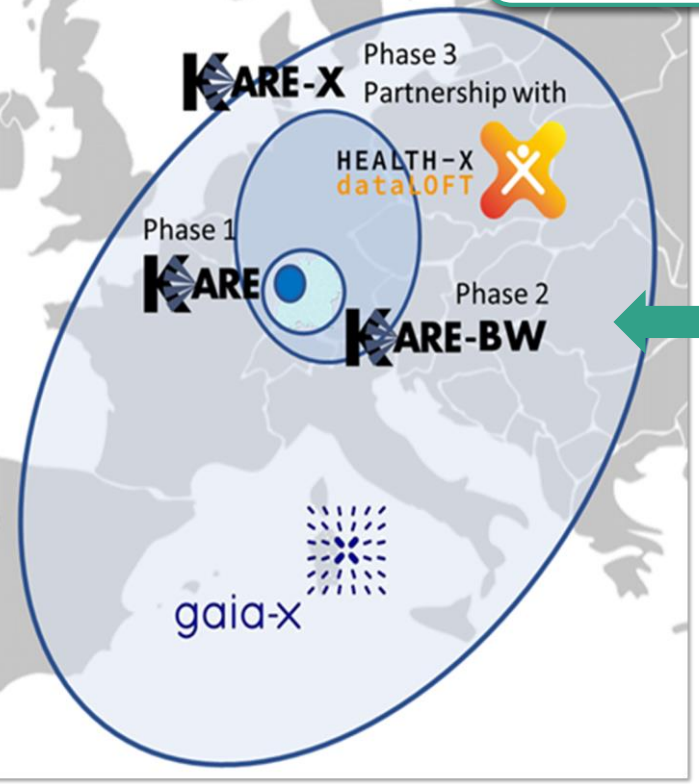
Teaching

Study Program
Medical Technology

- Bachelor and Master Programs
- Specialization for Other Study Programs
- Graduate Schools
- upCAT Accelerator

KARE: Data Space Interoperability

KARE Karlsruhe Region of Health Technologies



Data Infrastructure/Cloud

Public Data/Metadata
- NFDI
- Anonymized data
- Research data
- Clinical studies

Research Data
- Research data
- Data from Health Tech Industry (Collaboration partners)
- NFDI4Chem

AI

AI

KI-Methods Development for Interoperability of Data
- Automatic access to APIs
- Structuring of data

Systems Tools and Basic Technologies
- KI-based Hardware
- Distributed KI

Simulation and Digital Twin
- Personalized medication
- Simulation in digital twin models
- Machine learning on heterogeneous data

EDGE

Society

Data Provider-Oriented Data Utilization
- Real world labs
- Local (Edge)/offline to cloud

KARE-Data Space

Interoperable data infrastructure

KARE-Privacy

Privacy data

KARE-Innovation

Accelerated market launch of innovations

KARE-Digital Patient

AI-based health research Digital patient.

Research on AI systems for interoperability of all types of data spaces
(research data (e.g. biomaterials, smart wearables), health data, weather, mobility, etc.).

KARE-Digital Patient and „HealthAIfy“

The KARE Data Space as the basis of AI-based health research and establishment of the digital patient.

- **Incorporating evidence-based research data and building the digital patient based on interoperable data spaces.**
- Combining personal health data with evidence-based research data (P3 MSE Materials Research).
- Consolidated data in standardized infrastructure is essential enabler for AI-based research
- **Establishment of personalized computer models that accompany patients over a long period of time (digital twin)**

SZ.de Zeitung Magazin Jetzt Alle SZ-Produkte

Süddeutsche Zeitung

Ukraine Streiks Politik Wirtschaft Meinung Panorama Sport München Kultur

Neues KIT-Zentrum für Gesundheitstechnologien startet

1. März 2023, 10:59 Uhr

Direkt aus dem dpa-Newskanal

Karlsruhe (dpa/lsw) - Neue Technologien für Präzisionsmedizin, humanoide Roboter im Gesundheitswesen oder Cybersicherheit zu sensibler Daten: Da auch die Medizin zuseh digitaler wird, widmet sich am Karlsruher I Technologie (KIT) ein neues Zentrum für Gesundheitstechnologien den damit verbu Herausforderungen. Mehr als 150

ANZEIGE

www.faz.net/agenturmeldungen/dpa/neues-kit-zentrum-fuer-gesundheitstechnologien-startet-187142

DCASTS BLOGS THEMEN TICKER ARCHIV STELLENMARKT

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Stand: 01.03.2023 | Lesedauer: 2 Minuten

Neue Technologien für Präzisionsmedizin, humanoide

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https://www.landtag-bw.de/home/aktuelles/dpa-nachrichten/2023/Maerz/KW9/Mittwoch/bdab7441-ec3c-41b1-9a11

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Hochschulen

Neues KIT-Zentrum für Gesundheitstechnologien startet

1. März 2023, 10:59 | Artikel teilen

Neue Technologien für Präzisionsmedizin, humanoide Roboter im Gesundheitswesen oder Cybersicherheit zum Schutz sensibler Daten: Da auch die Medizin zusehends digitaler wird,

Hochschulen

Neues KIT-Zentrum für Gesundheitstechnologien startet

1. März 2023 um 11:01 Uhr

Neue Technologien für Präzisionsmedizin, humanoide Roboter im Gesundheitswesen oder Cybersicherheit zum Schutz sensibler Daten: Da auch die Medizin zusehends digitaler wird, widmet sich am Karlsruher Institut für Technologie (KIT) ein neues Zentrum für Gesundheitstechnologien den damit verbundenen Herausforderungen