Technische Hochschule Ingolstadt

AUDI KONFUZIUS-INSTITUT INGOLSTADT

HUAWEI European Research Center

THI-SCUT: Artificial Reality Research and Cooperation

AI for digital transformation, research and society

Dr. Cristian Axenie

https://audi-konfuzius-institut-ingolstadt.de

AUDI
KONFUZIUS-INSTITUT
INGOLSTADT

Agenda

A perspective, current projects and future work

- Introducing AKII Microlab
- VIRTOOAIR: VIrtual Reality TOOlbox for Avatar Intelligent Reconstruction
- When AI meets VR for society
- Previous projects in AI and VR
- Next steps

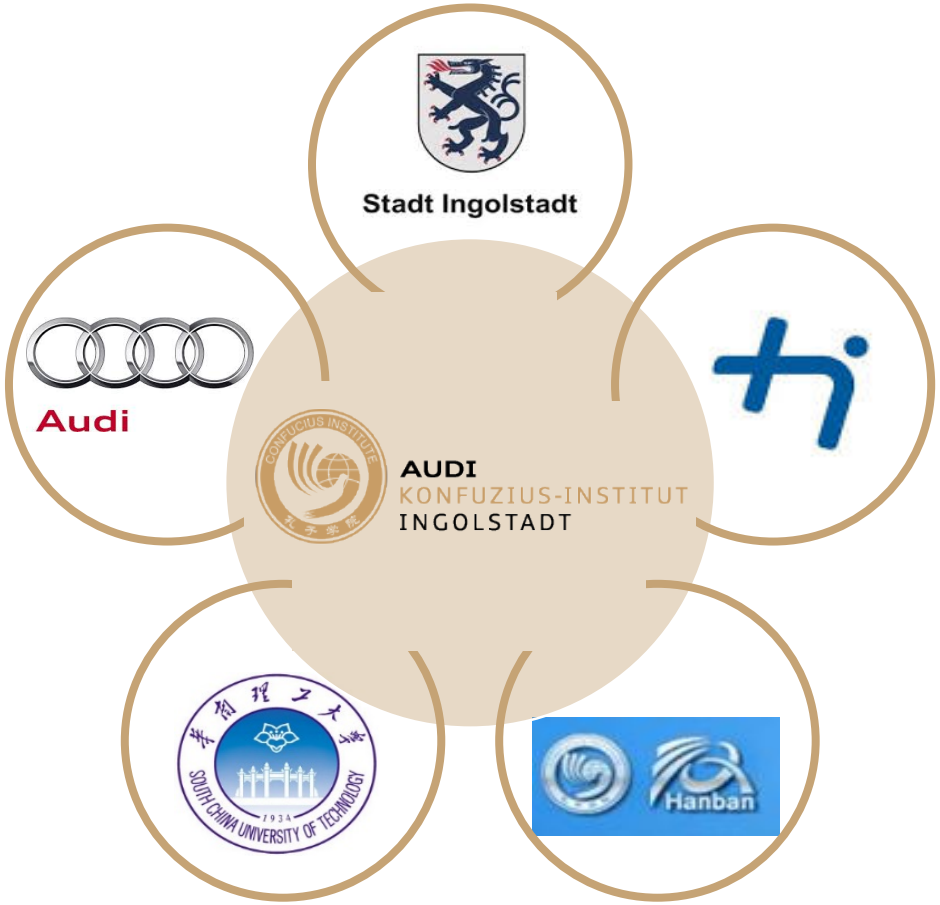
Introducing AKII Microlab

Confucius Institutes in Germany

Audi Konfuzius Institut Ingolstadt (AKII)

Specialization in Technology, Innovation, Management and Sustainability

- Among **19 locations** in Germany, **AKII** is **unique** in its **focus**.
- **AKII** offers the usual **basic Chinese language** and **cultural** programs.
- **AUDI** and the **Local Administration Ingolstadt** are dominant partners bringing a **technological**, **innovation management** and **sustainability** component to AKII.
- **AKII** has an **advisory board** from **SCUT** and **THI** as academic components.



Introducing AKII Microlab

DR. CRISTIAN AXENIE,
GROUP LEADER,
PI IN AI AND ML

PROF. DR. THOMAS GRAUSCHOPF,
PI IN VR

ARMIN BECHER,
PHD STUDENT

SEBASTIAN POHL,
MSC STUDENT

STEFAN SCHIECHEL,
BA STUDENT

MARTIN KUNZ,
BA STUDENT

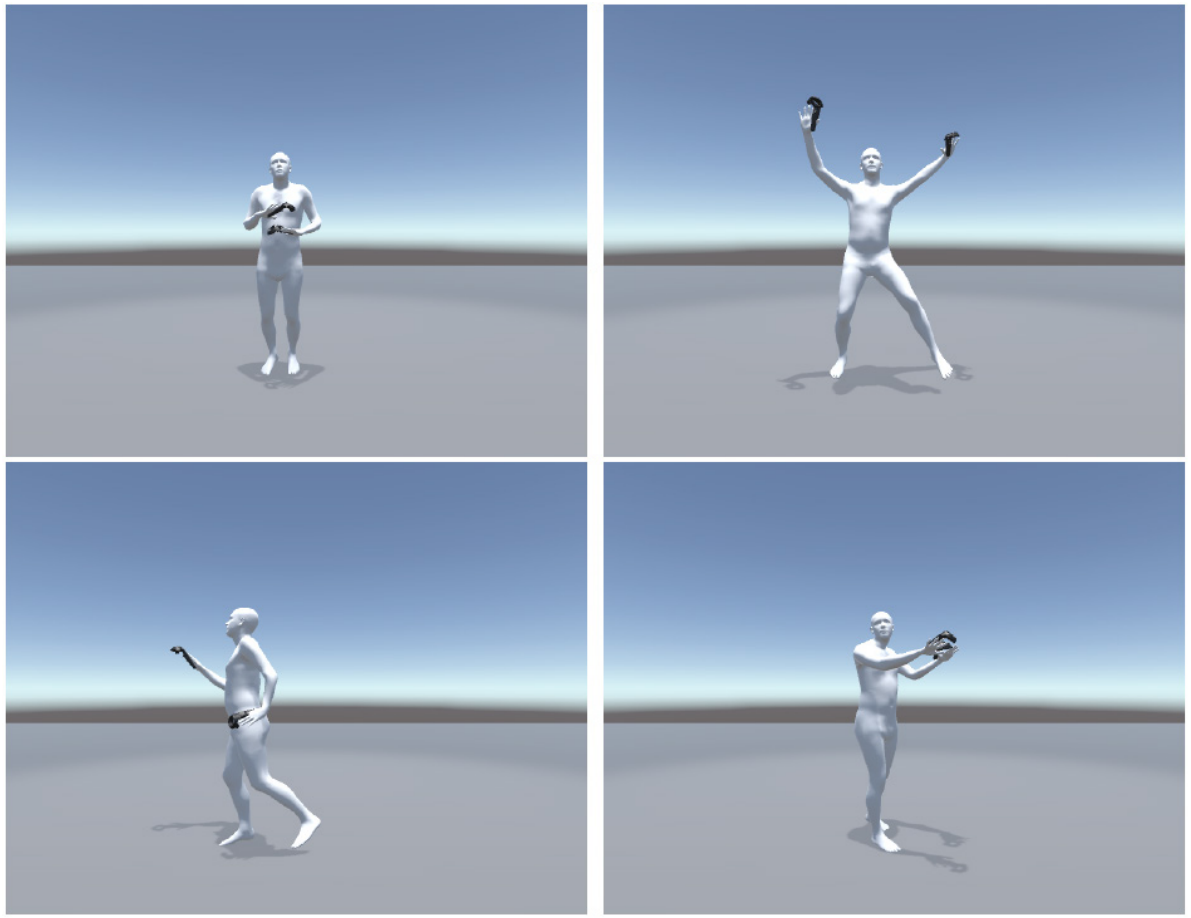
MARTIN GNAHN,
BA STUDENT

VIRTOOAIR

VIrtual Reality TOOlbox for Avatar Intelligent Reconstruction

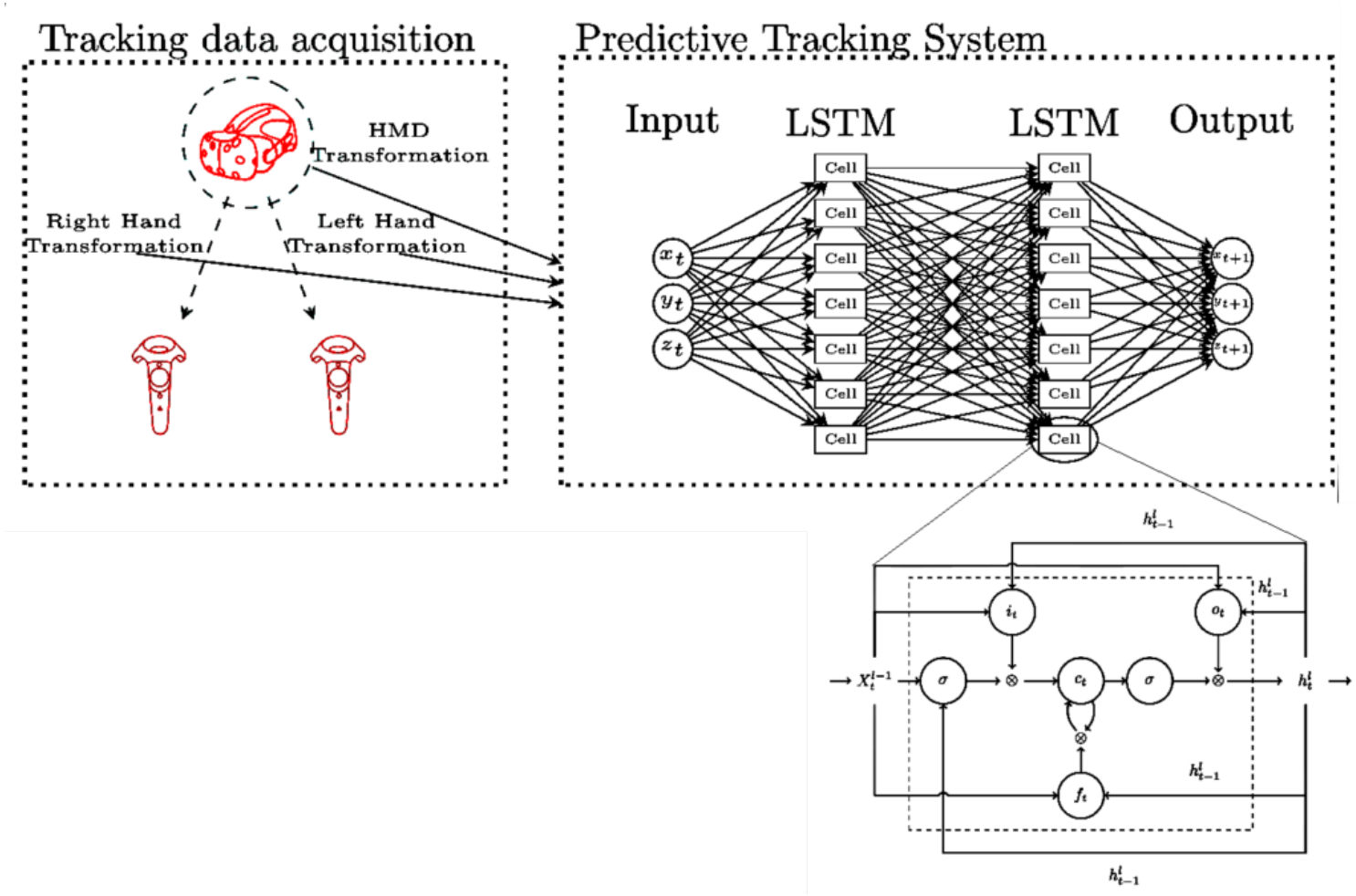
VIRTOOAIR – Current development

- a simple, yet efficient, approach for avatar motion reconstruction
- combines Deep Learning for upper body reconstruction
- most recent and efficient approaches for single camera based pose recovery methods for the lower body.



VIRTOOAIR – Current development

- infrastructure built on a **modular architecture** comprising:
  - a **predictive avatar tracking** module; an inverse kinematic learning module; an efficient data representation and compression module.



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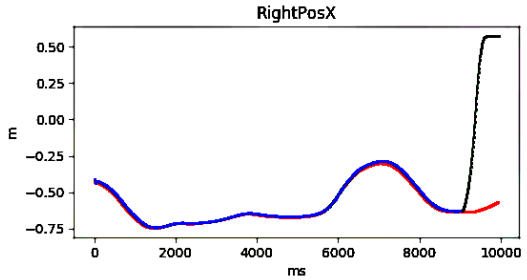

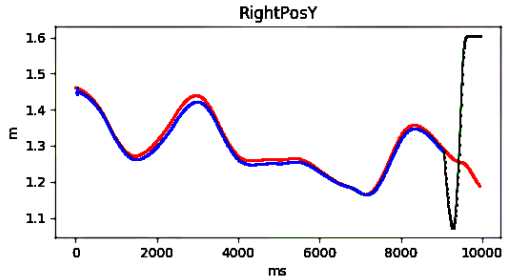

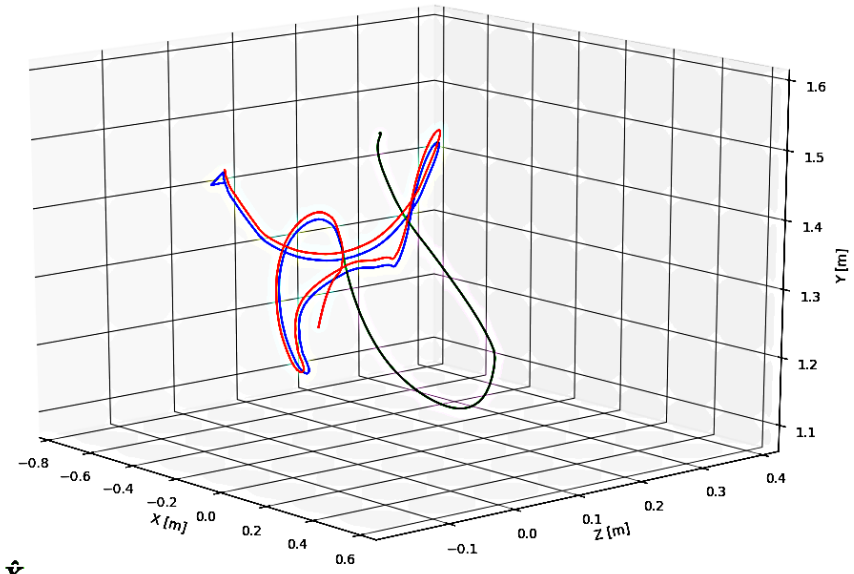

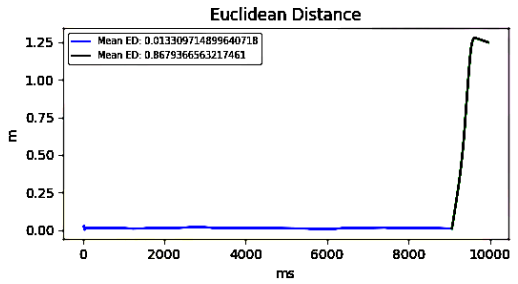

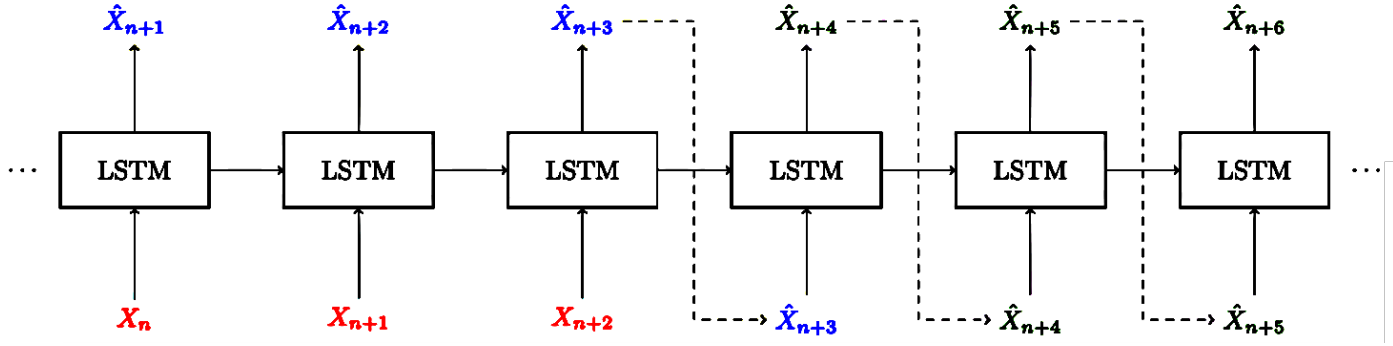

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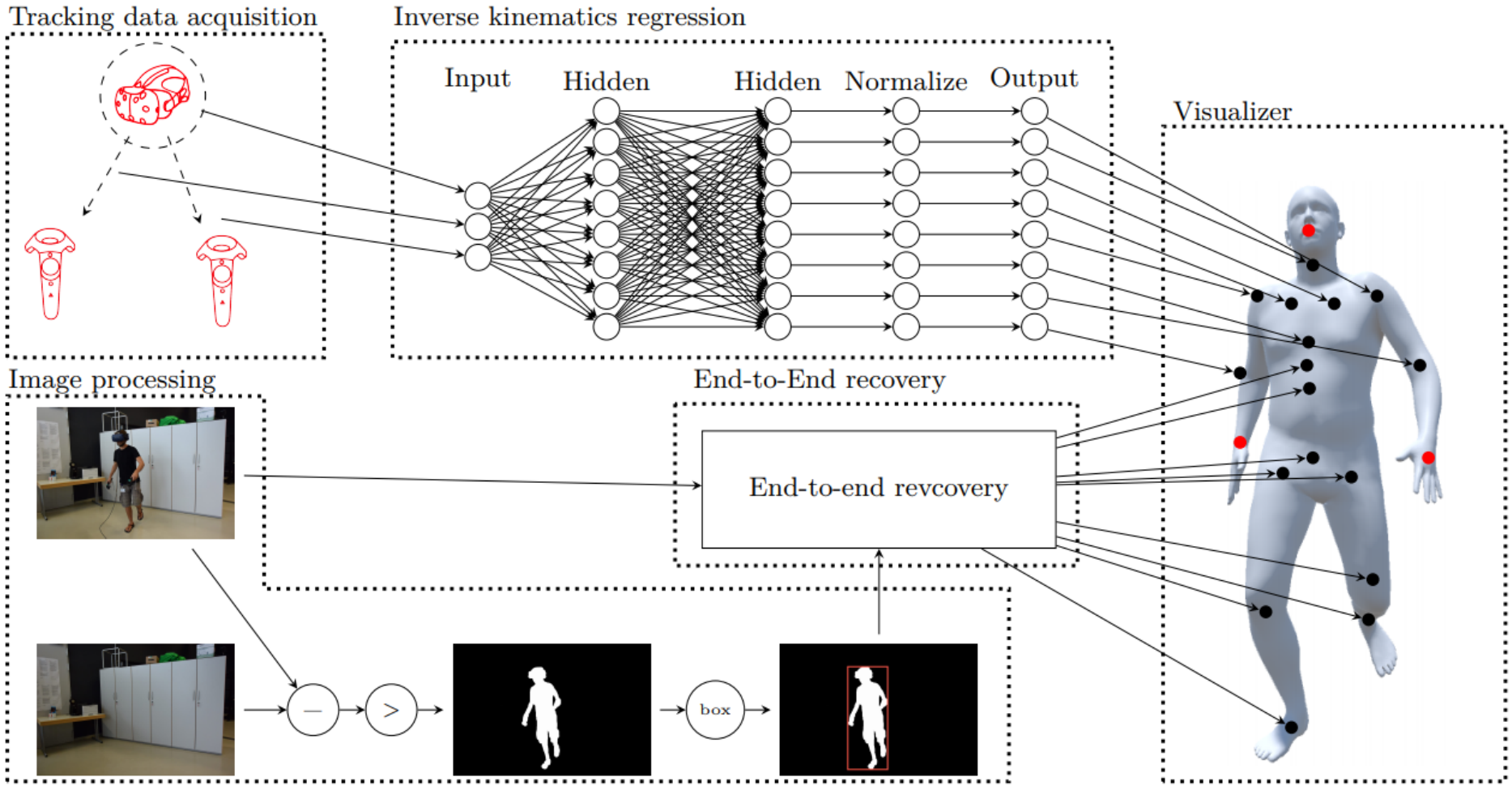

VIRTOOAIR – Current development

- infrastructure built on a **modular architecture** comprising:
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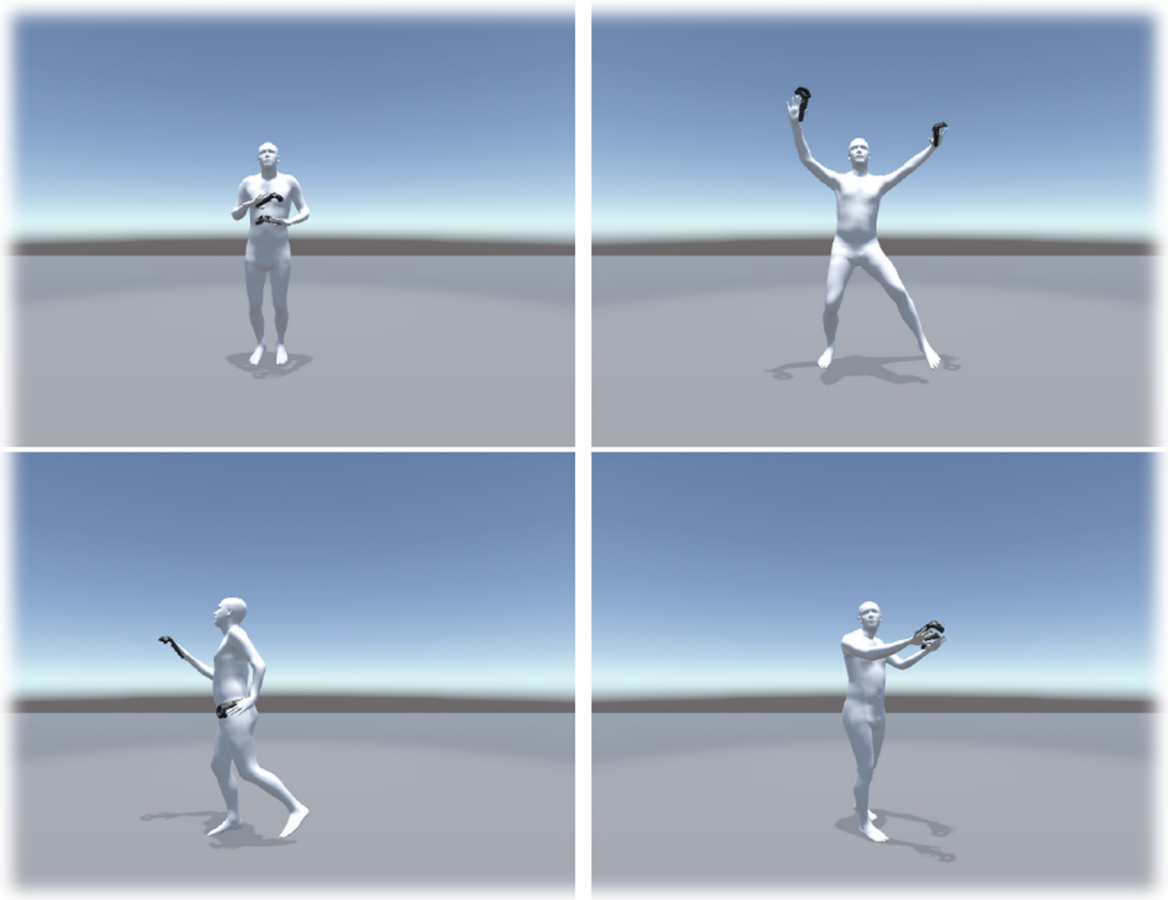
Method	MPJPE	MPJRE	Time
Limb	29.5 mm	67.9°	**0.1 ms**
CCD [20]	54.7 mm	105.8°	0.8 ms
FABRIK [2]	43.7 mm	88.4°	0.2 ms
VIRTOOAIR	**25.8 mm**	**13.9°**	2.2 ms



VIRTOOAIR – Current development

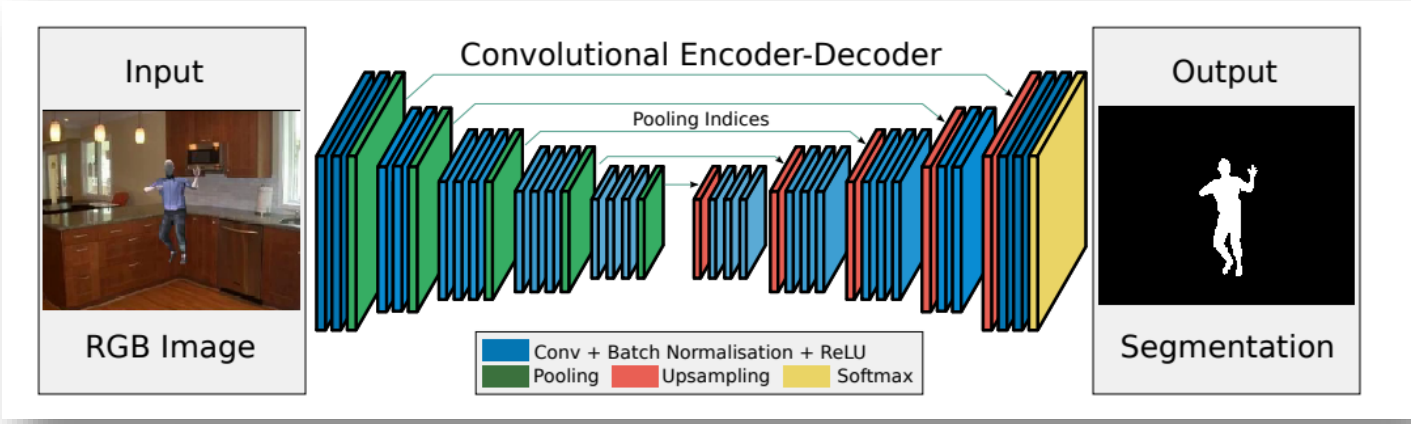
- infrastructure built on a **modular architecture** comprising:
  - a predictive avatar tracking module; an inverse kinematic learning module; an efficient data representation and compression module.
  - extensions for highly-realistic rendering: **silhouette extraction,** light probing and texture extraction.

SilhouetteFinder

The work compares and evaluates different algorithms to analyze their capabilities.

Starting from simple robust algorithms like difference imaging which only work for static backgrounds we investigated more versatile and flexible implementations, e.g. optical-flow based algorithms or deep learning based ones.

The project also explores the use of non-conventional, frameless cameras (event based).



VIRTOOAIR – Current development

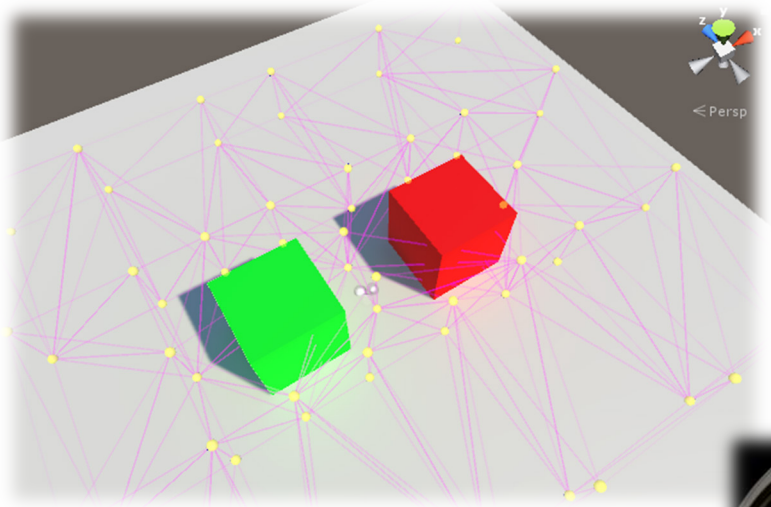
- infrastructure built on a **modular architecture** comprising:
  - a predictive avatar tracking module; an inverse kinematic learning module; an efficient data representation and compression module.
  - extensions for highly-realistic rendering**:** silhouette extraction, **light probing** and texture extraction.

LightProber

Realistic lighting conditions are extremely important in VR and light probing is a standard technique.

In such a task, one or more trackable light probing objects (most likely one diffuse reflecting white sphere and one specular reflecting sphere) are moved in the tracking area of the VR setup.

Through analysis of the video stream we reconstruct an environment map which can be used for image based lighting.



VIRTOOAIR – Current development

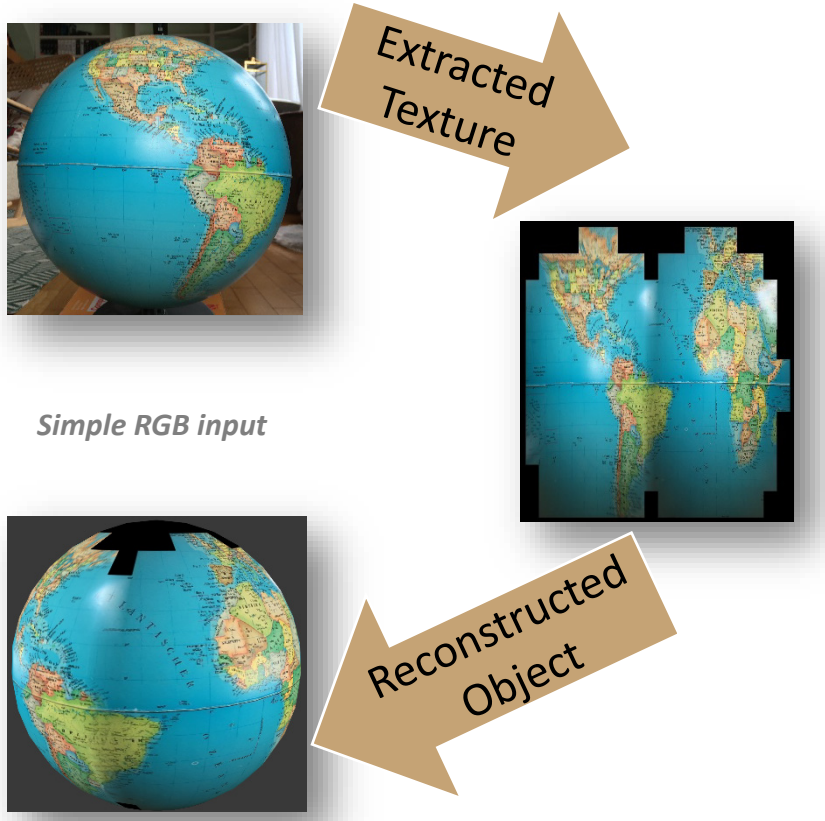
- infrastructure built on a **modular architecture** comprising:
  - a predictive avatar tracking module; an inverse kinematic learning module; an efficient data representation and compression module.
  - extensions for highly-realistic rendering: silhouette extraction, light probing and **texture extraction.**

TextureExtractor

Given the silhouette of the user in a RGB stream, we can easily extract the relevant pixel data for the user.

Furthermore, there exists a corresponding 3D model of the user's avatar in the correct pose. The environment is homogeneously well-lit.

In this project we create a UV-mappable texture for the 3D avatar from the 2D pixel-based color information.



When AI meets VR for society

When AI meets VR for society

VolkswagenStiftung

Artificial Intelligence and the Society of the Future

Grant application in review

Educational Technologies (EdTech)

VIRTOOAIR EDTECH

Virtual Reality TOOlbox for Avatar Intelligent Reconstruction in EDucational TECHnology

- **Combine AI and VR**
- Augment **teaching methodologies** and **learning techniques**
- Use in **remote** and **online learning**.

- Build a **high-fidelity** for **avatar reconstruction**,
- **pose** and **shape** to **facial expressions** and **dynamic textures**,
- **integrate** other **sensors**, such as **audio**, for a **dynamic merging** of **virtual** and **real objects**

- Will contribute to the advancement of **teaching methodologies**
- **easy adoption**
- relatively **immediate integration** in the educational process.

- International and interdisciplinary consortium.

Immersive Design Research Lab

virtuelle hochschule bayern

California State University Long Beach

Sample experience: Solar System Lecture

When AI meets VR for society

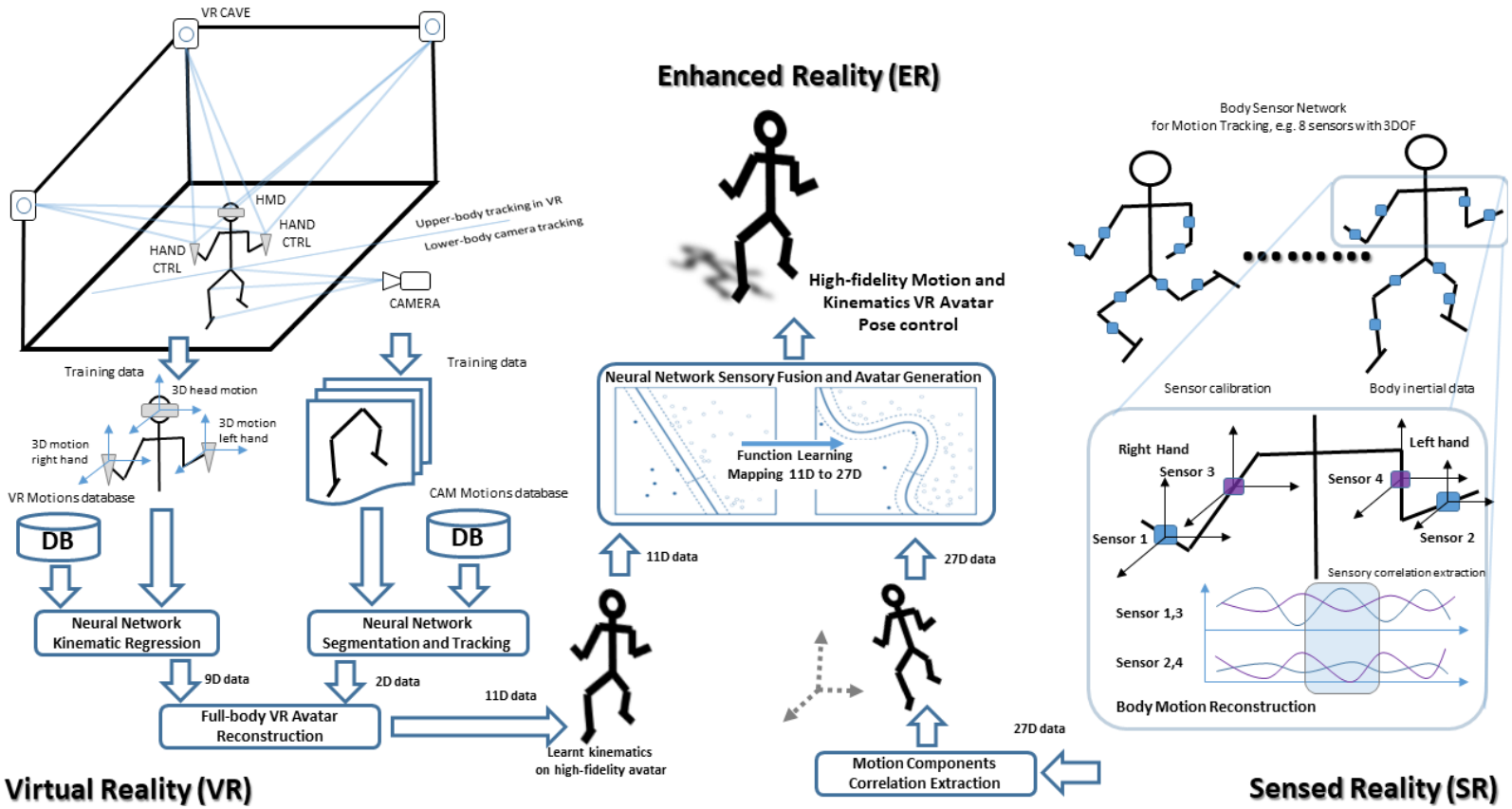
When AI meets VR for society

Physical Rehabilitation Technology

VIRTOOAIR REHABTECH

Virtual Reality TOOlbox for Avatar Intelligent Reconstruction in Rehabilitation Technology

MOREPHEUS: MOtor **R**ehabilitation in an **E**xtended reality **P**latform using **H**igh-fidelity **E**xercise **U**nderstanding and **S**ensing



ABB

ABB Research Award
in Honor of Hubertus von Gruenberg

Grant application in review

MOREPHEUS

AI POWERED VR FOR PHYSICAL REHABILITATION

- **MOREPHEUS**: **MO**tor **R**ehabilitation in an **E**xtended reality **P**latform using **H**igh-fidelity **E**xercise **U**nderstanding and **S**ensing.
- **VR and AI** that lead to an innovative engineering solution with clear societal impact, **personalized** motor **rehabilitation** and **posture control** in **Parkinson's Disease** patients.

When AI meets VR for society

When AI meets VR for society

Automotive Inspection Technology

VIRTOOAIR AUTOTECH

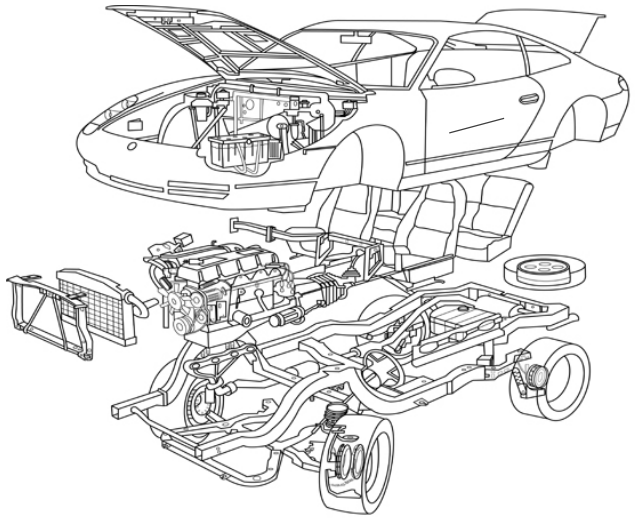
Virtual Reality TOOlbox for Avatar Intelligent Reconstruction in Inspection Technology

150 JAHRE TÜV NORD

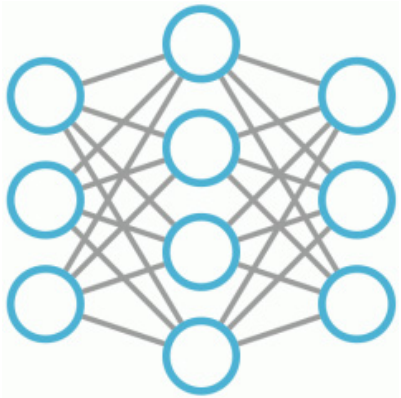
Planning pilot project

- Automated visualization & AI analysis of car damage / homologation inspection data in VR
  - AI based Anomaly / defect (scratch) finding in 360 images of cars.
  - Homologation problems.

AVANTI: **A**utomated **V**R visualization and **A**I u**N**derstanding of **T**ÜV **I**nspections

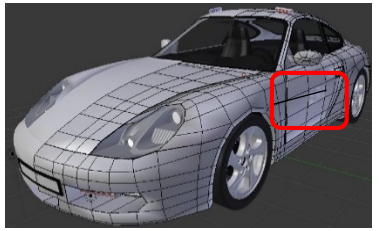


Explosion diagram of car or 3D pictures

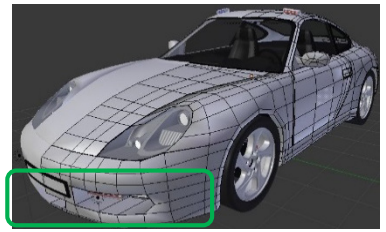


Deep Neural Network

TÜV® USED VEHICLE INSPECTION REPORT



Detected scratch



Detected custom tuning

When AI meets VR for society

When AI meets VR for society

ZIM
Zentrales Innovationsprogramm Mittelstand

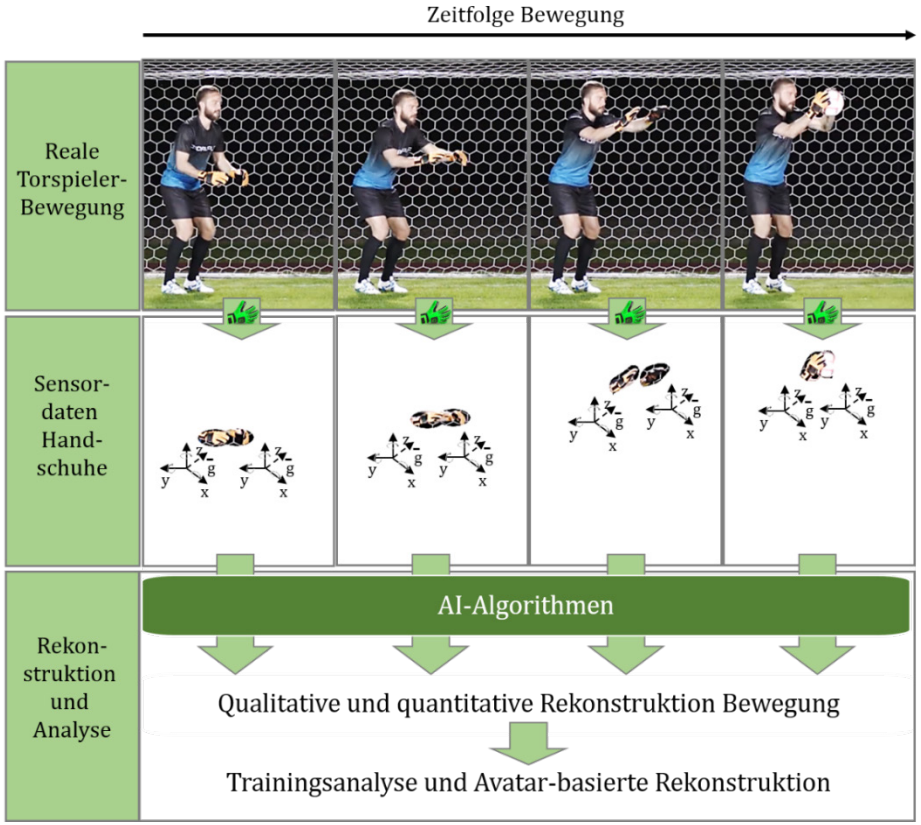
Planning project

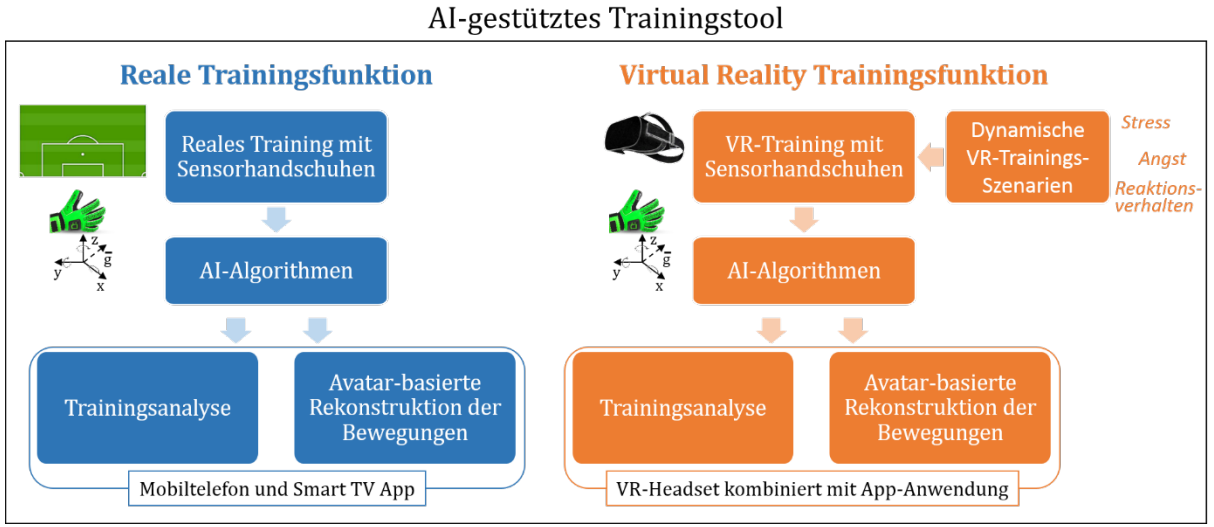
Rehabilitation Technology

VIRTOOAIR SPORTTECH

Virtual Reality TOOlbox for Avatar Intelligent Reconstruction in Sports Training Technology

- Combine AI and VR Goalkeeper Biomechanical and Psychological Training





When AI meets VR for society

When AI meets VR for society

Medical Technologies (MedTech)

VIRTOOAIR MEDTECH

Virtual Reality TOOlbox for Avatar Intelligent Reconstruction in MEDical TECHnology

- **precise avatar representation** in **VR** for **pain management** and **attenuation**.
- **high-end VR** with **precise avatars** may **decrease** the number of **treatment sessions** and may **reduce** or **eliminate** the need for **pharmaceutics** during painful procedures.
- Potential direction: **Peripheral Neuropathy caused by chemotherapy.**
  - **muscle** or **joint aches** are prevalent symptoms
  - **Taxanes** are believed to induce **sensorimotor neuropathy** by impairing **neurons' function**.
  - The **symptoms**:
    - numbness in the hands and feet,
    - tingling in the hands and feet, sensitivity to cold temperatures, nerve pain, muscle/joint aches, muscle weakness, and loss of balance.
- Local interdisciplinary collaboration.

Helios Klinikum München West

Akademisches Lehrkrankenhaus der
Ludwig-Maximilians-Universität München

Daria Kurz

Leitende Oberärztin

Gynäkologisches Krebszentrum

Interdisziplinäres Brustzentrum

Planning collaboration

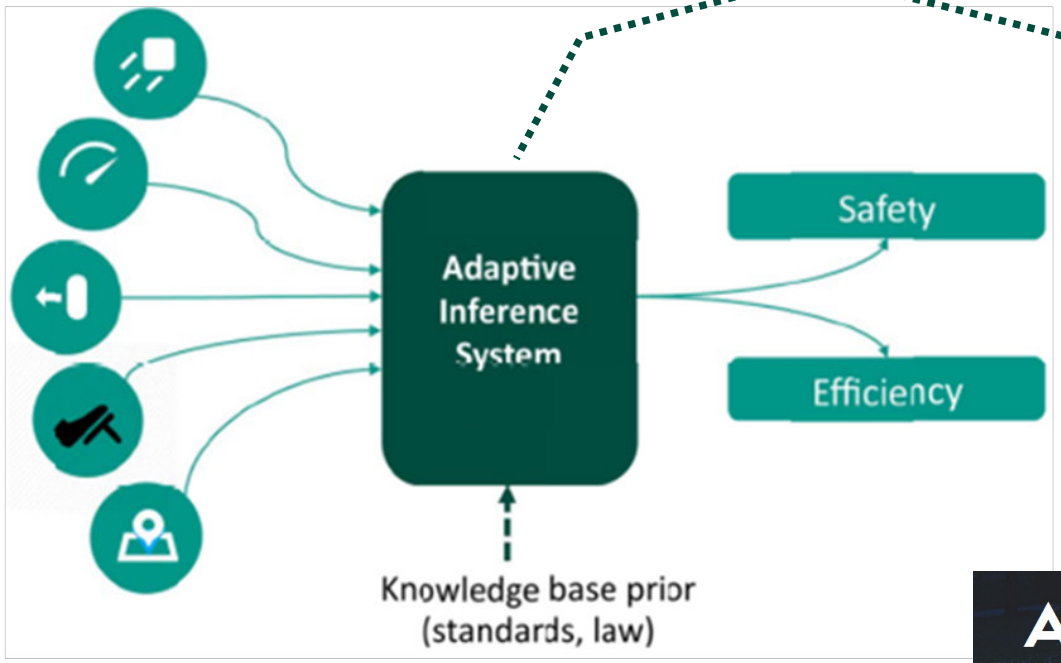
Easy adoption setup

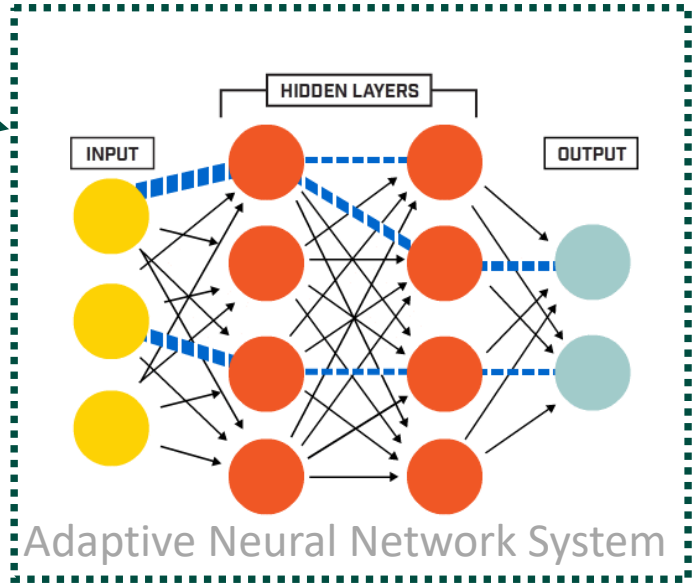
Previous projects in AI and VR

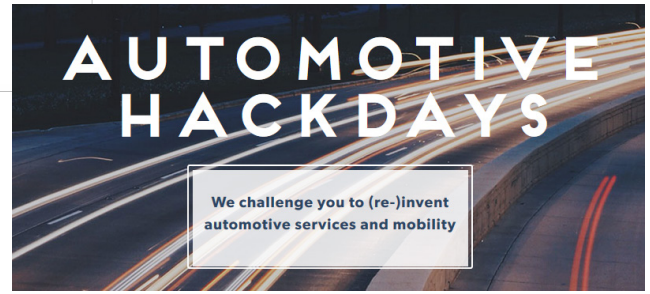
AI in the digital world – Automotive

BMW Automotive Data Hackdays* – Mobility SaaS *(Project completed)*

The Automotive Hackdays are a 5 day coding event where developers, designers, engineers and makers get together to rapidly prototype and iterate new automotive concepts using data gathered from real BMW and MINI cars.







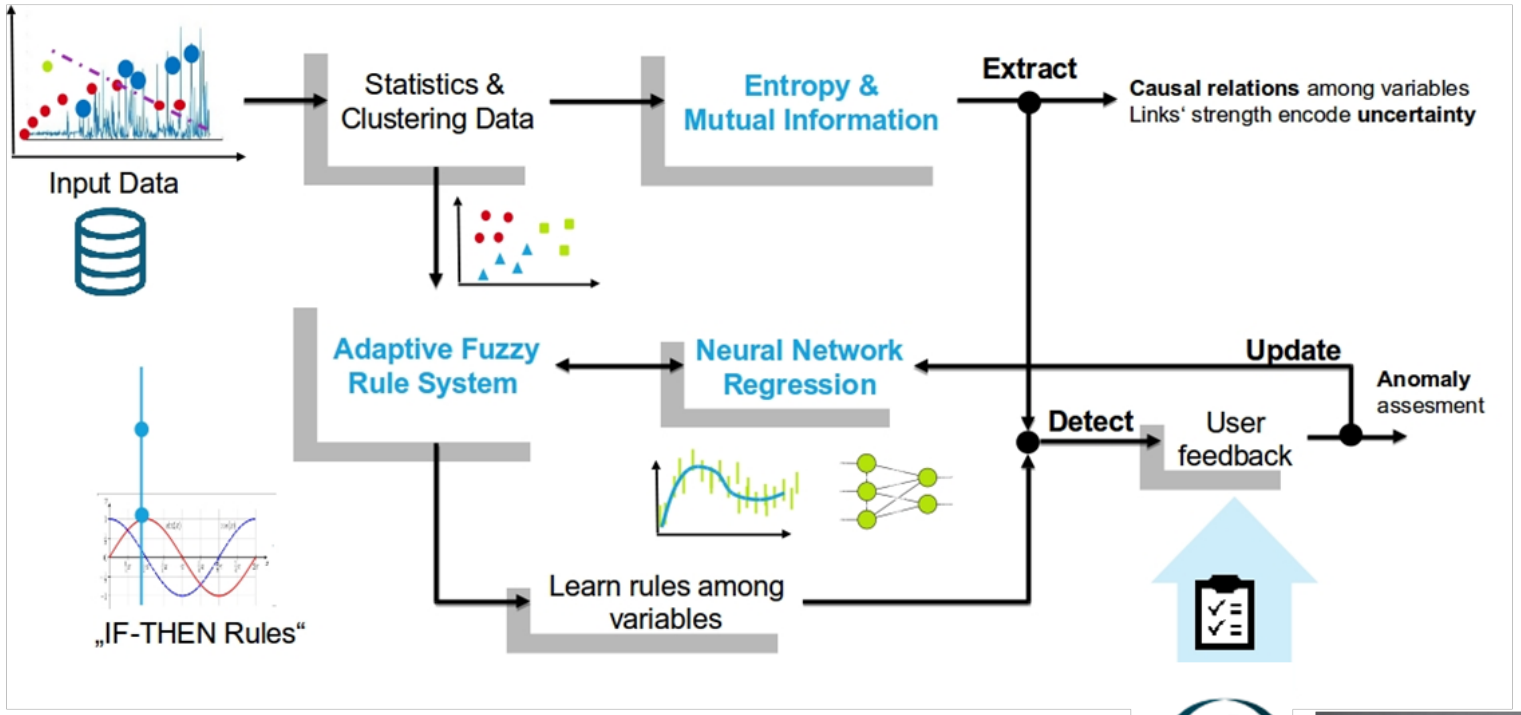
unternehmertum
Center for Innovation and Business Creation at TUM

***Awarded 1st prize (5000EUR)**

AI in the digital world – Fintech

Daimler Financial Tech Data Hackaton* – Anomaly Detection Agent *(Project completed)*

Develop an AI agent constantly runs through the data (leasing contracts in Sweden) and makes the user aware of potential data inconsistencies, incorporates user's feedback and adapts.



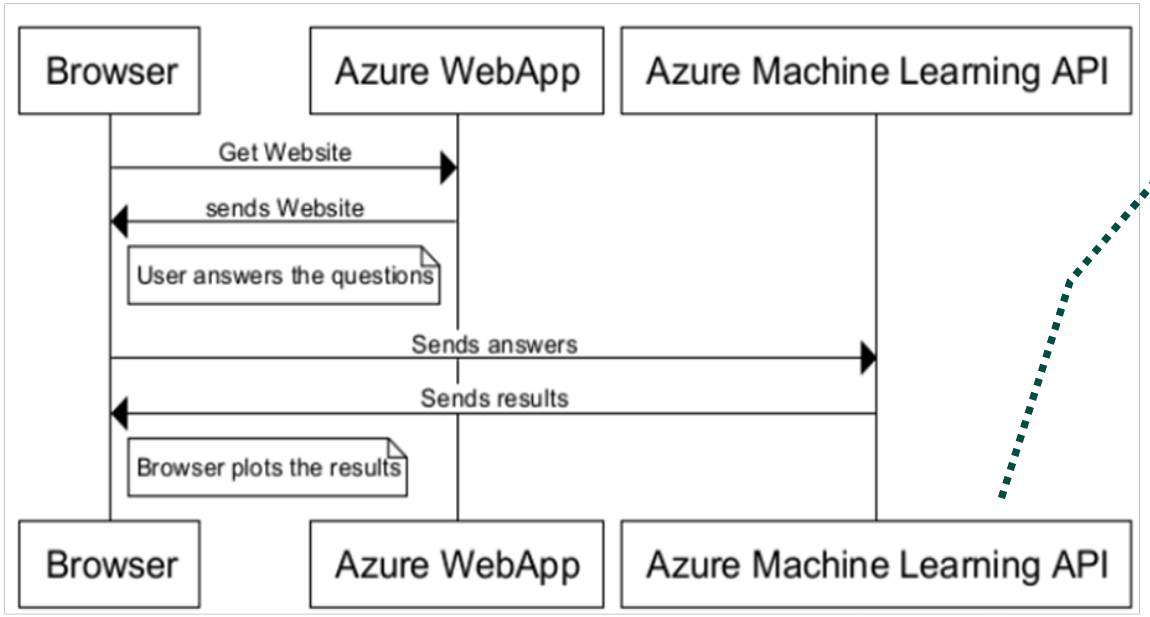
DAIMLER

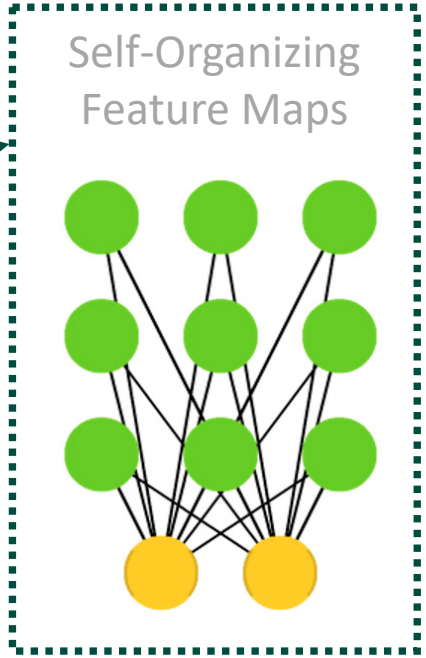
*Awarded 1st prize

AI in the digital world – HR and Psychology

Burda HR Data Hackaton* – Psychometric Data Mining *(Project completed)*

Using neural networks to learn the complex patterns that exist among and between the responses to items in questionnaires. These could represent crucial aspects of human personality if only they could be made available to human resource professionals.





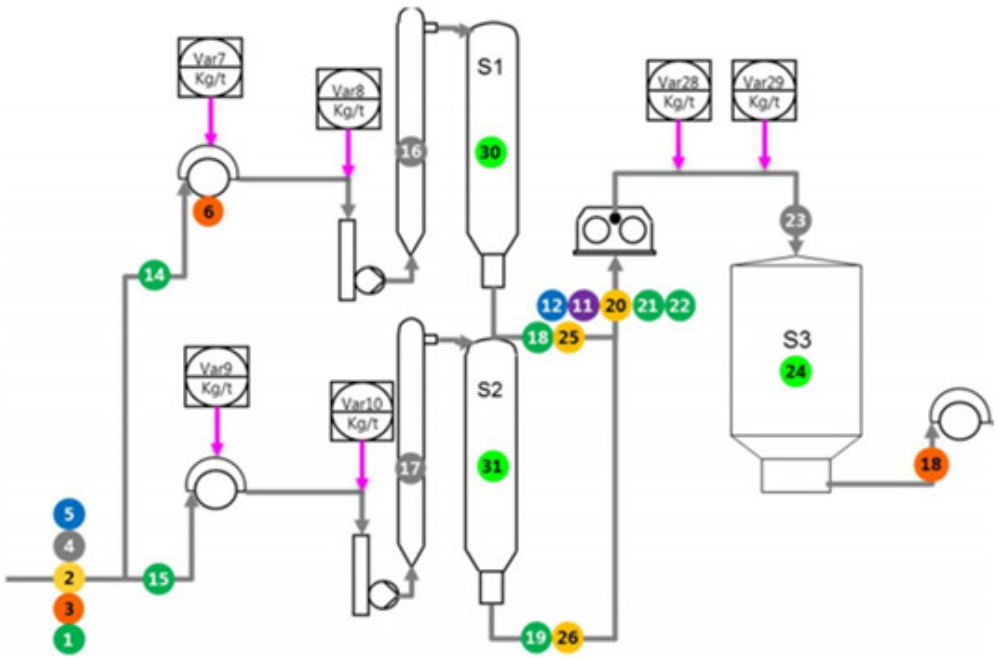
Hubert Burda Media

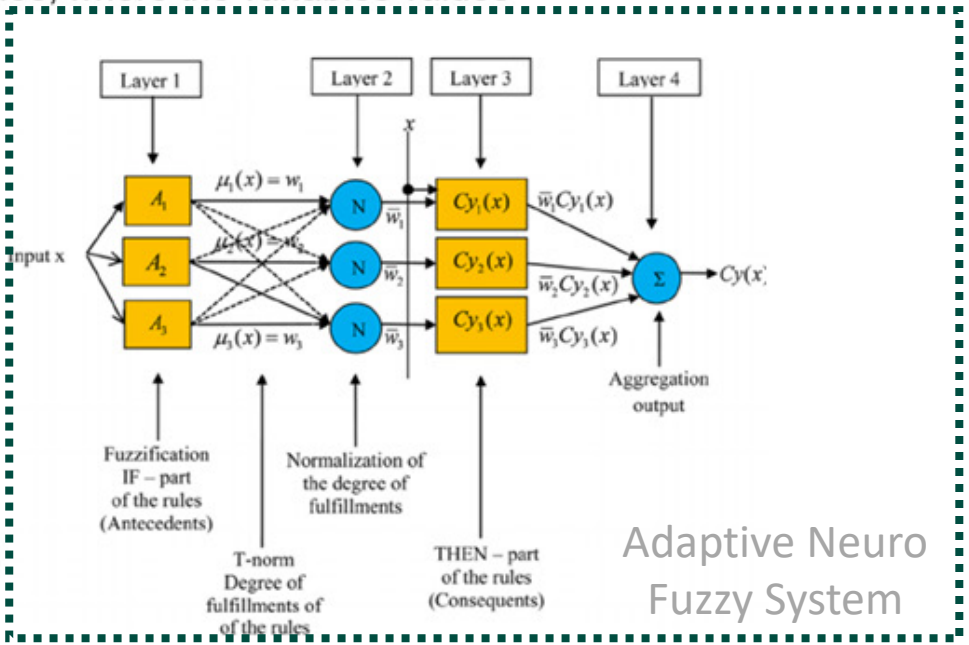
***Awarded Microsoft Cognitive Technologies Prize**

AI in the digital world – Industrial Automation

Andritz Big Data Analytics – Industrial Process Optimization *(Project completed)*

The task was to find relationship between alarms, operator actions and process data from some pulp and paper mill. The process data was given as time series, where the variables values always have a timestamp.





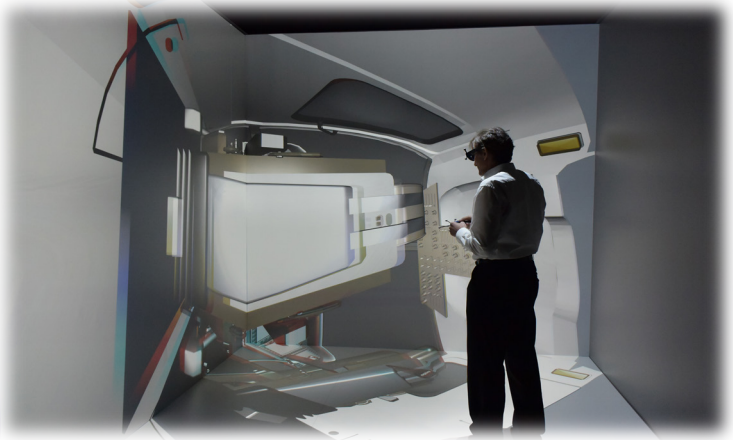
Adaptive Neuro Fuzzy System

ANDRITZ

VR in the digital world – Automotive *(Projects ongoing)*

- Automotive projects for collaborative VR:
  - High-end renderings;
  - Construction validation;
  - Virtual installation;
  - Ergonomics.
- Latencies in distributed VR causes misunderstandings and decreases the efficiency.
- Cooperation with Audi to develop a measurement system to measure delays between distributed VR systems.

High-end renderings



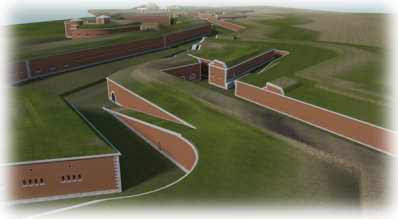
Construction validation

Virtual installation for ergonomics

VR in the digital world – Artistic performances and historical projects *(Projects completed)*

- The Futurologische Kongress is an art and interactive media event in cooperation with the Theater Ingolstadt.
- Over 14.000 people visit the congress and THI for an interactive 3D experience in the VR CAVE.

Game playing



High-end renderings

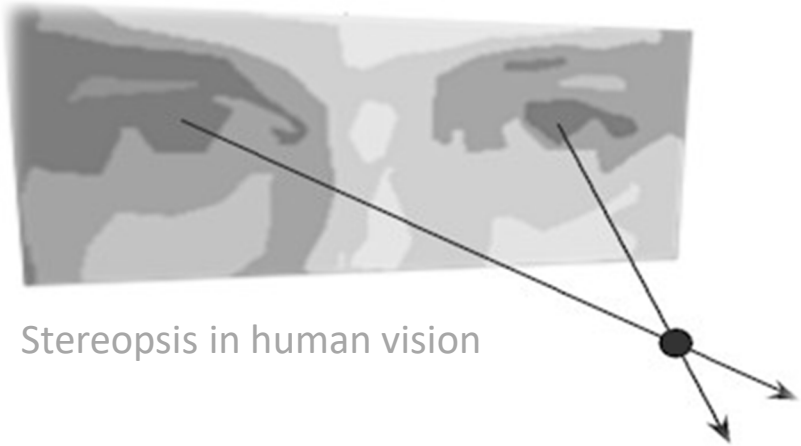
- Virtual Reconstruction of the Ingolstadt Fortress as of 1875.
- Collaboration with public instutions and companies.

VR in the digital world – Rehabilitation *(Project completed)*

- Software to treat deficiency in stereopsis – perceiving depth using our two eyes using an immersive VR.
- Cooperation project and preliminary tests with optometrists of Brillenburg Ingolstadt.
- Preliminary study shows the effectiveness of the system in improving depth perception.

System setup

Software interface and functionality



Stereopsis in human vision

Next steps

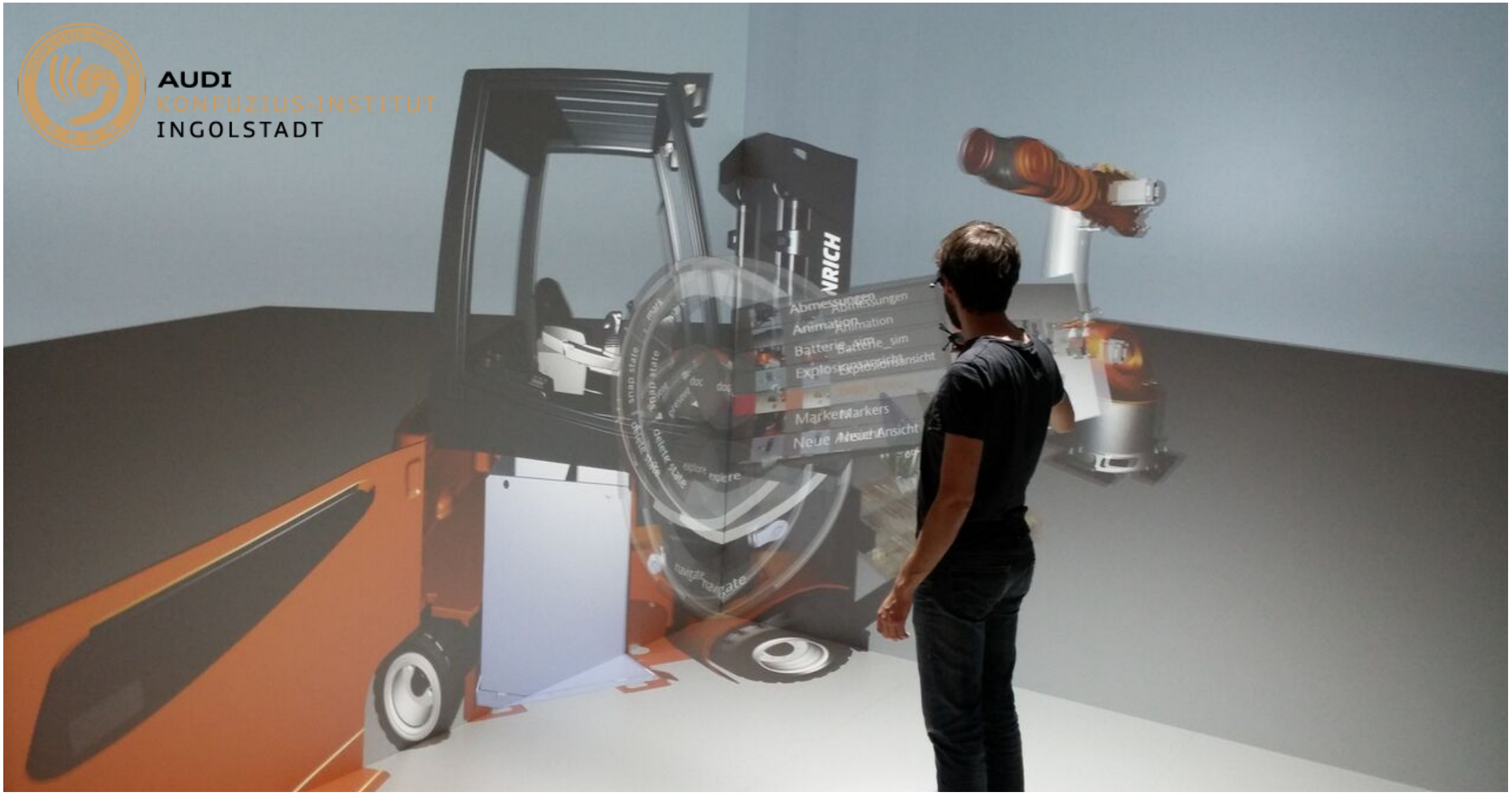
Next steps

Technische Hochschule Ingolstadt

SOUTH CHINA UNIVERSITY OF TECHNOLOGY

AUDI
KONFUZIUS-INSTITUT
INGOLSTADT

- To introduce current research and explore overlap in research for short-term project.
- To lay down the implementation plan of a Student Exchange Program (program with AKII stipend).
- To explore and design new joint research & development programs for long-term projects.


AUDI
KONFUZIUS-INSTITUT
INGOLSTADT
Abmessungen
Animation
Batterie_sim
Explosionsansicht
Markers
Neue Ansicht