#ANNUAL_REPORT.2020

INNOVATION CENTER COMPUTER ASSISTED SURGERY

#SMART_OR
#HYPER_SPECTRAL_IMAGING
#WORKFLOW  #MR_GUIDED_INTERVENTIONS
#FOCUSED_ULTRASOUND
#MEDICAL_TECHNOLOGIES MADE_SMART
#ROBOTICS  #MODELBASED_MEDICINE
#PERSONALISED_MEDICINE
#LIFE_SUPPORT_SYSTEMS
IMPRINT

EDITOR
Leipzig University
Faculty of Medicine
Innovation Center Computer Assisted Surgery (ICCAS)

Semmelweisstraße 14
04103 Leipzig
Germany
E-Mail: info@iccas.de
Web: www.iccas.de

EXECUTIVE DIRECTOR
Prof. Dr. Andreas Melzer

CONCEPT & LAYOUT
Sabrina Jans
Christoph Zeumer

COVER
ICCAS’ 15 years of Research-Collage.

PHOTOS
ICCAS I Innovation Center Computer Assisted Surgery
Universität Leipzig I Medizinische Fakultät
Universität Leipzig I Swen Reichhold
Colourbox
Deutschen Gesellschaft für Medizinische Physik I DGMP

GRAPHIC ARTS
Simon Rosenow
Christoph Zeumer

DISCLAIMER
All data in this report is due to the Institutes specifications.
No responsibility can be accepted for the correctness of this information.

Leipzig, March 2021
CONTENTS

PREFACE ................................................................................................................................................ 7

ICCAS TIMELINE ................................................................................................................................... 8

FACTS AND FIGURES ........................................................................................................................... 10

SELECTED ACTIVITIES .......................................................................................................................... 12
Highlights ................................................................................................................................................ 12
Selected Events ...................................................................................................................................... 13
Project Related Activities ....................................................................................................................... 15

HONORS AND AWARDS .......................................................................................................................... 17

INTERRELATED RESEARCH PROJECTS ................................................................................................. 18
Computer-Assisted Image-Guided Interventions ................................................................................... 20
Model-Based Medicine and Intelligent OR ............................................................................................ 30
Biomedical_Data_Analysis ....................................................................................................................... 38
Intraoperative Multimodal Imaging ........................................................................................................ 39

PUBLICATIONS .................................................................................................................................... 42
Journal and Book Publications, First- and Senior Authorship ............................................................ 42
Co-Authorship ....................................................................................................................................... 44
Conference Proceedings ......................................................................................................................... 46

EVENTS ................................................................................................................................................ 47
In-House Events .................................................................................................................................... 47
Conferences, Symposia, Workshops ........................................................................................................ 48
Presentations at Fairs ............................................................................................................................... 51
Project- and Cooperation Work .............................................................................................................. 52
University Courses ................................................................................................................................. 54
Graduations ........................................................................................................................................... 55

ORGANIZATION ..................................................................................................................................... 56

COOPERATION PARTNERS ...................................................................................................................... 60
Dear Friends and Colleagues,

2020 has been the most challenging year of the past 15 years overshadowed by the COVID-19 pandemic and related restrictions. Nonetheless, we were able to continue our crucial work in a goal-oriented manner with the outstanding support of our motivated employees.

ICCAS started in 2005 as a Research Center for Innovation funded through the BMBF program Unternehmer Region, which was established for supporting the new eastern states of Germany. After 15 years of successful research and development we are looking back at achievements of nearly 50 million euros in external funding, 468 peer-reviewed publications, 282 conference proceedings and two spin-off companies. In 2020, ICCAS has been established as an Institute at the Faculty of Medicine of Leipzig University. The two main research areas of Computer-Assisted Image-Guided Interventions and Model-Based Medicine and intelligent OR are growing and a large number of multidisciplinary scientists are working interrelated and closely together towards the greater goal of the ultimate intelligent hybrid operating room for smart medical technologies in surgical and interventional care.

Despite significant and still ongoing lockdowns in 2020, ICCAS staff performed extraordinarily well mostly under difficult home office conditions. Online tools and electronic communication systems allowed us to continue with current running projects and we were able to stick to almost all of our objectives. Our funding bodies are mentioned with gratitude for flexible management of some delays. We would also like to cordially welcome Prof. Ivanova and her group supporting ICCAS research in the field of Biomedical Data.

Eight new projects were launched with a total value of more than 4.47 million euros. The large 6.75 million euro SONO-RAY BMBF project in collaboration with Oncoray and the projects IMPACT and ENSEMBLE were successfully completed and results published. We are particularly proud of establishing three industry-funded projects in 2020. Karl Storz GmbH is funding a joint project of ICCAS and Diaspective Vision GmbH to develop Endoscopic Hyperspectral and Multispectral Imaging (HSI and MSI) techniques. This activity is significantly supported through preclinical studies by more than six clinical departments of University Hospital Leipzig (UKL) spearheaded by Prof. Ines Gockel, Director of the Department of Visceral Surgery, and her colleagues. Three patent applications have already come out of this exciting project. For our second industry-funded project avateramedical® GmbH Jena has contracted ICCAS for the modeling and simulation of
instrument positioning to facilitate the clinical introduction of their new surgical robotic system in close collaboration with Prof. Jens-Uwe Stolzenburg, Director of the Department of Urology at UKL, who is one of the inventors and founders of avatera. Finally, Janssen Cilag Deutschland GmbH, the pharma branch of Johnson and Johnson, funds an exciting project in the context of digital patient models for hematology in close collaboration with Prof. Uwe Platzbecker, Director of the Department of Hematology at UKL.

The newly developed Service-Oriented Device Connectivity (SDC) family of IEEE standards, in whose development ICCAS was involved and that became ISO standards, is currently extended to future medical communication systems. For this, ICCAS was initiator and founding member of the 5G Health Association.

ICCAS has been involved in numerous online events, offered networking opportunities and brought current research topics such as Artificial Intelligence into focus. The main effort was focused on the scientific organization of the BMT 2020, which took place for the first time as a virtual conference from 29 September to 1 October attracting more than 520 attendees. Our novel clinically interlinked format of the conference program became known as the “Leipzig Model”. Additionally, the iSMIT Conference 2020, Chicago, was held online as well, stretched over 5 days in December 2020 spanning over 12 time zones on three continents, and was attended by more than 600 people.

We would like to thank everyone involved for the successful year 2020 and we are looking forward to meeting you in person again soon.

Stay safe and healthy!

Kind regards

Prof. Dr. Andreas Melzer

Prof. Dr. Thomas Neumuth
### ICCAS TIMELINE

#### 2020
- 15th anniversary of ICCAS – Greetings and video message by Saxon Minister for Science Sebastian Gemkow
- Institute at the Faculty of Medicine at Leipzig University
- BMT in Leipzig – Opening by Federal Minister of Health Jens Spahn
- New Research Group Biomedical Data Analysis with project PostStoke (Prof. Galina Ivanova)
- Avatera Cooperation: Instrument Positioning
- Launch of projects VITALS, KAIT, MSI-Endoscopy, HSI-Laparoscopy, AIQ-NET, SORLIC, AutoCuff, Brainsaver

#### 2019
- ICCAS organizes the 'FutureMedTechnologies' doctoral workshop and transfer meeting
- Habilitation of Dr. Claire Chalopin
- OR.Net e.V. presents the SDC-Standard at DMEA 2019
- 6th Digital Operating Room Summer School successfully performed
- ICCAS conducts a public discussion on AI in Medicine in the framework of the BMBF’s Year of Science
- Launch of projects MR-Stents, MR Thrombosis, MOMENTUM, MPM and ProDial

#### 2018
- ICCAS welcomes Saxony’s Prime Minister Michael Kretschmer
- 5th Digital Operating Room Summer School inspired international participants
- ICCAS takes part at the Surgical Robot Challenge of the Hamlyn Symposium in London
- ICCAS hosts Steering Committee Meeting of the European Modular Field Hospital project
- ICCAS invites to the 17th Annual Conference of the CURAC-Society
- Launch of projects: ENSEMBLE, COMPASS and LYSiS
- EU Commissioner for Humanitarian Aid & Crisis Management Christos Stylianides visits ICCAS

#### 2017
- ICCAS meets Federal Chancellor Angela Merkel at Digital Summit 2017
- 4th Digital Operating Room Summer School consolidates its unique feature
- EUFUS 2017 & Preconference Workshop Experimental FUS and HIFU take place in Leipzig
- Successful non-invasive treatments with HIFU at Leipzig University Hospital
- RESEARCH AREA Life Support Systems with projects IMPACT and EMU launches
- Start of projects European Modular Field Hospital, PAPA-ARTIS and MoVE

#### 2016
- Final presentation of the flagship project OR.Net
- ICCAS receives ISO 13485 certification
- Federal health minister visits ICCAS
- 3rd Digital Operating Room Summer School – DORS 2016
- Project start of Meta-ZIK SONO-RAY
2015
- Launching of cooperation with several scientific and clinical institutions
- Tenth anniversary of ICCAS with second DORS and ICCAS International Symposium
- Project OR.Net: Presentation of results in the complete demonstrator
- NEW RESEARCH AREAS: Noninvasive Image Guided Interventions (Prof. Andreas Melzer), Multimodal Intraoperative Imaging (Dr. Claire Chalopin)
- Clinical Advisory Board founded
- New Advisory Board members: Prof. Ron Kikinis and Prof. Günter Rau

2014
- Prof. Andreas Melzer joins ICCAS as Director as well as professor of computer assisted surgery
- IT Innovation Award for „oncoflow“
- First Digital Operating Room Summer School – DORS 2014

2013
- TPU including „oncoflow“ launched at Leipzig University Hospital
- PascAIl (Patient Simulation Models for Surgical Training and Teaching) – research project by Leipzig University and HTWK Leipzig
- ICCAS plays a key role in the national BMBF research project ‘OR.Net – Safe and Dynamic Networks in the Operating Room’
- Honorary Professorship of Biomedical Information Systems at the HTWK Leipzig: Thomas Neumuth
- Project ‘HWS – Structural Defect Classification and Modeling of the Cervical Spine’ in cooperation with the Institute of Anatomy (Leipzig University) and the Fraunhofer IWU, Dresden
- Researcher exchange programs with University of Southern California, ARTORG Center for Biomedical Engineering Research (University of Bern) and Fraunhofer MEVIS in Bremen

2012
- ICCAS starts academic courses at HTWK
- RESEARCH AREA – Digital Patient Model (Dr. Kerstin Denecke) starts

2011
- ICCAS participates in the DICOM WG24 group
- ICCAS’s demo OR 2.0 opens
- RESEARCH AREAS: Model-Based Automation and Integration (Dr. Thomas Neumuth) and Standards (Prof. Heinz U. Lemke)
- Advisory Board founded

2010
- Surgical Planning Unit (SPU) opens
- ICCAS teams up with HTWK Leipzig – establishment of the Innovation Surgical Training Technology (ISTT) under professorship of Werner Korb
# FACTS AND FIGURES

## HEADCOUNT

### 2016 2017 2018 2019 2020

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Associates</td>
<td>23</td>
<td>23</td>
<td>39</td>
<td>34</td>
<td>42</td>
</tr>
<tr>
<td>Research Associates (FTE)</td>
<td>19</td>
<td>25</td>
<td>29</td>
<td>28</td>
<td>33</td>
</tr>
<tr>
<td>Research Assistents</td>
<td>17</td>
<td>14</td>
<td>18</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Guest Researchers</td>
<td>13</td>
<td>10</td>
<td>20</td>
<td>32</td>
<td>26</td>
</tr>
</tbody>
</table>

## PUBLICATIONS

### 2016 2017 2018 2019 2020

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>31</td>
<td>42</td>
<td>35</td>
<td>28</td>
<td>26</td>
</tr>
<tr>
<td>First- and Senior Authorship</td>
<td>14</td>
<td>7</td>
<td>22</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>Co-Authorship</td>
<td>15</td>
<td>15</td>
<td>9</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Book Chapters</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Conference Proceedings</td>
<td>21</td>
<td>29</td>
<td>28</td>
<td>18</td>
<td>21</td>
</tr>
</tbody>
</table>
ICCAS’ main funding is provided by the BMBF Federal Ministry of Education and Research. Furthermore, ICCAS receives funding from the BMWi Federal Ministry for Economic Affairs and Energy for projects related to the ZIM Central Innovation Program for small and medium-sized enterprises. Leipzig University’s Faculty of Medicine provides ICCAS with performance-based funding.

Amount of ICCAS industry-funded project outputs in 2020.
HIGHLIGHTS

ICCAS BECOMES INSTITUTE | MAY 28, 2020 | ICCAS, LEIPZIG

ICCAS receives official recognition as an institute of the Leipzig University. After 15 years of outstanding research, The Innovation center has now been transformed into a scientific institution within the Faculty of Medicine. It is assigned to the clinical-practical teaching unit.

The whole ICCAS team would like to thank all those involved who have made this success possible!

BMT 2020 WAS A SUCCESS | SEPTEMBER 29 - OCTOBER 1, 2020 | ICCAS, LEIPZIG

The first virtual Conference of the German Society for Biomedical Engineering (BMT 2020) was co-hosted by ICCAS in cooperation with The Verband der Elektrotechnik, Elektronik und Informationstechnik e.V. (VDE) from September 29th to October 1st. The event, which was certified by the Saxon State Chamber of Medicine (SLÄK) with a total of 18 continuing education points, was opened by a video message from the Federal Minister of Health Jens Spahn. It also featured greetings from Saxony’s Science Minister Sebastian Gemkow on ICCAS’ 15th Anniversary.

The online conference attracted more than 500 attendees, with the participation of clinicians being particularly noteworthy. The “Leipzig Model” increased the clinical input: additional physicians accompanied the sessions and gave lectures from their practical experience.

Artificial Intelligence, Personalized Medicine and the new Medical Device Regulation were among the main subjects of the conference as well as topics from the Active Assisted Living (AAL) Congress and from the VDE BMT YoungNet initiative.

ICCAS’ current research topics were presented in several sessions, which were chaired by the two conference chairmen Prof. Andreas Melzer and Prof. Thomas Neumuth. Among them were the sessions on “Medical Imaging” and “Robotics” as well as on “5G”, “AI in Medicine”, and “Model-based Personalized Medicine”. During the conference, ICCAS was represented with a total of 14 unique contributions.

The ICCAS-team would like to thank all contributors for the successful course of the event and the important scientific exchange. Next year, the Hannover Medical School invites to
the 55th Annual BMT Meeting in Hannover in the hope of a real-life reunion.

**SELECTED EVENTS**

**ICCAS STATUS SEMINAR 2019 | JANUARY 23, 2020 | ICCAS, LEIPZIG**

At the annual Status Seminar, ICCAS took stock of the past year and presented its research results to numerous guests. Leipzig University’s Prorector for Research Prof. Erich Schröger congratulated ICCAS for its 15th anniversary and praised its far-reaching visibility and networking. Following the oral reports from the research divisions, the scientists held demos at 7 stations providing insights into the (further) development of our project themes: imaging robotics, MR-guided interventions, medical technology networking, imaging procedures in accident and visceral surgery, cancer cell sensitization and digital therapy decisions.

**MY HOLIDAY ADVENTURE ‘ICCAS’ | FEBRUARY 13, 2020 | ICCAS, LEIPZIG**

Within the framework of this year’s holiday program “My Holiday Adventure Leipzig” (MEFALE), children of employees of Leipzig University Medicine gained exciting insights into ICCAS’ research activities. The young visitors had the opportunity to try out a medical robotics application and a hyperspectral imaging system themselves. For example, they took pictures of their hands with a hyperspectral camera, through which the skins’ blood circulation was made visible thanks to this special type of imaging technology. The children kept the images as souvenirs.

**PROF. THOMAS NEUMUTH IN UNI-LECTURE SERIES | MARCH 3, 2020 | UB, LEIPZIG**

Prof. Thomas Neumuth gave a lecture on Digitization in Medicine to interested citizens in the full hall of the Bibliotheca Albertina. He
presented the healthcare of tomorrow: personalized, preventive, predictive and participatory, supported by the use of new technologies.

PROF. ANDREAS MELZER AT THE EUROPEAN ROBOTICS FORUM (ERF) | MARCH 3-5, 2020 | MALAGA, SPAIN

Prof. Andreas Melzer participated in the European Robotics Forum (ERF) – the largest and most influential event in the field of robotics and artificial intelligence in Europe. He was involved in the workshop and plenary discussion on robotics in healthcare, where he elucidated the application potential of robotics for image-guided therapy and focused ultrasound to support minimally and non-invasive interventions.

ICCAS - 5G PIONEER IN MOBILE MEDICAL TECHNOLOGY | MAY 14, 2020 | BMW PLANT, LEIPZIG

Within the framework of the project “Trimodal 5G Pioneer Region Leipzig North” (Tri5G), Prof. Thomas Neumuth and a team of ICCAS scientists presented the research on emergency care using mobile medical technology in interaction with public 5G and campus networks. Tri5G aims to make the 5th generation mobile internet available for the automotive industry, logistics and IT companies as well as for scientific and public applications in the north of Leipzig. The City of Leipzig commissioned a feasibility study, whose results were presented at the BMW plant in Leipzig in May, 2020.

ROBOT DEMOS FOR MEDICAL PHYSICISTS | SEPTEMBER 9, 2020 | VIRTUAL

Within the framework of this year’s 51st Annual Meeting of the German Society for Medical Physics (DGMP), experts from the German Society for Biomedical Engineering (DGBMT) participated with two guest sessions. They provided insights into the latest research and development of various expert
committees and demonstrated medical robot applications from ICCAS and the German Cancer Research Center (DKFZ).

PROJECT-RELATED EVENTS

KICK-OFF PROJECT MPM AT ICCAS | MARCH 2, 2020 | ICCAS, LEIPZIG

The first meeting of all partners in the project ‘Models for Personalized Medicine’ (MPM) funded by The Federal Ministry of Education and Research with 5.1 million Euros took place at ICCAS. The joint project with seven local industrial partners aims to develop assistance applications for personalized tumor therapy. The partners introduced themselves and explained their intended research contributions.

The partners of the project Models for Personalized Medicine at the kick-off in Leipzig. © ICCAS.

ICCAS DEVELOPS INFORMATION SYSTEM FOR COVIDVAL PATIENT STUDY | APRIL, 2020 | LEIPZIG

The COVIDVAL PRO (patient reported outcome) system, developed by ICCAS for the COVIDVAL trial, is an information system for tracking and documenting the health status of SARS-COV-2 quarantined patients outside of clinical settings. Tracking begins from the time of SARS-COV-2 testing at the clinical facility, from which point on the system provides various electronic and paper-based communication channels for patients to document parameters relevant to the progression of their health status. This way patient data can be collected telematically, so that personal consultations in the study center are minimized.

The COVIDVAL patient study has been funded by the Federal Ministry of Education and Research and it involves randomized conversion from ACE inhibitors to angiotensin receptor blockers (ARB) and use of ARB vs. placebo in SARS-COV-2 infection. (https://covidval.de/)

STATUSWEBINAR COMPLETES SONO-RAY PROJECT | JUNE 18, 2020 | ONLINE

At the public status webinar of the expiring BMBF joint project SONO-RAY, the two partners OncoRay and ICCAS presented their final project results. Since 2016, the scientists around Prof. Andreas Melzer (ICCAS) and Prof. Mechthild Krause (OncoRay) have been researching on a new tumor therapy method that combines magnetic resonance-guided focused ultrasound and radiation therapy. They were
able to verify positive thermal and mechanical effects of FUS on cancer cells and developed a robotic system for the exact positioning of the ultrasound radiation therapy. In a pilot study in Dresden, the first patients with localized prostate cancer have been receiving treatment with FUS since September 29. The preliminary results are summarized in a recent publication and present a major step towards clinically oriented implementation of the combination therapy.

Press release (German)

MEDICAL DEVICE EVALUATION VIA ARTIFICIAL INTELLIGENCE: ICCAS LAUNCHES A NEW PROJECT | 2020

Due to the new Medical Device Regulation (MDR) of the EU, the requirements for reliable medical device data are continuously increasing. Currently, the market surveillance is often characterized by a lack of skilled personnel in industry and hospitals, cost pressure, legal uncertainty and IT systems with low interoperability. These aspects will be addressed in the AIQNET project (Artificial Intelligence for Clinical Studies). With the help of artificial intelligence, epidemiological, clinical, para-clinical and radiological data can be automatically analyzed and used for the performance evaluation of medical devices.

Press release (German)

Janssen Germany aims to improve the treatment of blood cancer through the use of artificial intelligence (AI). To this end, the research-focused pharmaceutical company supports a research project in which ICCAS and the Clinic for Hematology Cell Therapy and Hemostaseology at Leipzig University Hospital serve as the leading technology partners. Together they are pursuing the goal of developing an AI-based digital health platform for therapeutic decision support for patients with complex blood disorders. The KAIT platform will be accessible to physicians in clinics and practices and provide them with evidence-based suggestions for individualized therapy strategies. In three years the KAIT platform will be available as a reliable and practical tool to support clinical routines.

Press release (German)
DR. ANDREA SCHENK JOINS ICCAS’ SCIENTIFIC ADVISORY BOARD | FEBRUARY, 2020
ICCAS welcomes Dr. Andrea Schenk as a new member of its scientific advisory board. She is member of the management board at the Fraunhofer Institute for Digital Medicine (MEVIS). Her research activities focus on image processing of multimodal data as well as on clinical decision and image-based therapies.

PROF. ANDREAS MELZER BECAME FELLOW ACADEMY OF MEDICAL SCIENCES | 2020
Prof. Andreas Melzer became fellow of the Academy of Medical Sciences (UK) and has been appointed as visiting Professor of the Korean National Cancer Center and as a member of the ERC SAP (Science after the Project) panel to evaluate the outcome of ERC Advanced Grants.

PROF. THOMAS NEUMUTH HAS BEEN ELECTED MEMBER OF THE EUROPEAN COMMISSION’S EXPERT PANEL “EXPAMED” | SEPTEMBER, 2020
Prof. Thomas Neumuth has been appointed to the European Commission’s expert panel “Expamed”, which aims to improve regulation in the approval process of medical devices (MDR) and medical devices for in vitro diagnostics (IVDR).

ICCAS WELCOMES ITS FIRST FEMALE BOARD MEMBER | DECEMBER, 2020
ICCAS is happy to announce another new board member. Prof. Ines Gockel – Head of the Clinic for Visceral, Thorax and Vascular Surgery at the University Hospital Leipzig (UKL) has already been working closely with ICCAS in the capacity of a clinical advisor.

TWO NEW ADDITIONS TO ICCAS’ BOARD OF DIRECTORS FROM THE HEART CENTRE LEIPZIG (HZL) | DECEMBER, 2020
Prof. Gerhard Hindricks and Prof. Michael A. Borger will succeed Prof. Friedrich W. Mohr on the ICCAS Board of Directors. The ICCAS team welcomes the two clinical heart specialists from the Heart Centre Leipzig (HZL). Prof. Hindricks is an expert on cardiac arrhythmias and manages one of the largest European centers for the treatment of arrhythmias at the HZL. Prof. Borger’s clinical focus lies in minimally invasive aortic and mitral valve operation and robot-assisted cardiac surgery at the HZL.
#INTERRELATED RESEARCH

#LIFE_SUPPORT_SYSTEMS

#INTRAOPERATIVE_MULTIMODAL_IMAGING

#ROBOTICS
Interrelated research: #Computer_Assisted_Image_Guided_Interventions
#Model_Based_Automation_and_Intelligent_OR
#Intraoperative_Multimodal_Imaging
#Biomedical_Data_Analysis

#BIOMEDICAL_DATA_ANALYSIS

#MODEL_BASED_AUTOMATION

#DIGITAL_PATIENT_MODEL

#IMAGE_GUIDED_FOCUSED_ULTRASOUND

#MR_GUIDED_INTERVENTIONS
Research focuses on new technologies in the field of MRI-guidance to enable minimally and non-invasive procedures for patient-friendly diagnosis and treatment. In addition to improved soft tissue contrast, advantages of MRI include the absence of iodine-containing contrast agents and ionizing radiation. The project work aims to develop innovative MR-compatible instruments, investigate suitable medical workflows with restricted patient access and communication in the MR environment. Application of focused ultrasound, transfer of minimally invasive catheter intervention and robotic assisted procedures are established and evaluated.
‘ICCAS researches on new technologies for computer-assisted image-guided procedures. This theme is a logic development of the traditional ICCAS research on computer-assisted surgery towards less invasive image-guided surgery and interventions.’

**LEAD**

Prof. Dr. Andreas Melzer

**SCIENTIFIC STAFF**

Nikolaos Bailis, Denis Gholami Bajestani, Johann Berger, Julian Donig, Erwin Immel, Lisa Landgraf, Christina Mulik, Ina Patties, Annekatrin Pfahl, C. Martin Reich, Upasana Roy, Michael Unger

**SELECTED PUBLICATIONS**


SCIENTIFIC RESEARCH AREAS AND RELATED PROJECTS:

#COMPUTER_ASSISTED_IMAGE_GUIDED_INTERVENTIONS

## IMAGE_GUIDED_FOCUSED_ULTRASOUND – IGFUS:
- **SONO-RAY** | Tumor Therapy Combined by MR-Guided Focused Ultrasound and Radiation Therapy | Funding: META-ZIK of BMBF
- **CURE-OP** | Oncological Therapy Platform for Combined Ultrasound Radiation Therapy | Funding: BMBF
- **Imaging Robotics** | Concepts for Robotic-guided Focused Ultrasound Hyperthermia and Radiation Therapy in the Clinic | Funding: Freistaat Sachsen - SMWK
- **Prepositioning Avatera** | Optimizing the positioning principles of a novel robotic system | Funding: avateramedical GmbH
- **MRgFUS** | Non-invasive Magnetic – Resonance – Guided Focused Ultrasound (MRgFUS) in the treatment of uterine fibroids – collaborative project with UKL
- **LIFU** | Neuromodulation using transcranial ‘low intensity focussed ultrasound’ (LIFU) stimulation measured with EEG – collaborative project with MPI and Fraunhofer IBMT

## MAGNETIC RESONANCE-GUIDED INTERVENTIONS – MRGI
LEAD: CH. MARTIN REICH:
- **MR-Thrombosis-Theranostic** | MR-guided Minimally-invasive Diagnostics and Therapy of Thrombosis | Funding: BMBF
- **MR-Biopsy** | MR Safe Flexible Biopsy Forceps for Minimally Invasive Tissue Sampling | Funding: BMBF
- **MR-Stents** | MR-Guided Stent-Implantation | Funding: BMBF
RESEARCH AREA: IMAGE GUIDED FOCUSED ULTRASOUND - IGFUS

SONO-RAY PROJECT: FOCUSED ULTRASOUND (FUS) COMBINED WITH RADIATION THERAPY (RT) TO IMPROVE RADIOONCOLOGICAL TREATMENTS

The Sono-Ray project, a joint project of ICCAS (Leipzig) and OncoRay (Dresden) funded by BMBF, started in October 2016 and was concluded in August 2020 to investigate the effects of focused ultrasound (FUS) to improve the treatment outcome of conventional treatments including radiation therapy (RT) and hyperthermia (HT). FUS describes a unique technique using ultrasound beams to generate heat or cavitation effects in a target tissue inside the body in a non-invasive way under image-guidance and quantifiable temperature control in real-time via magnetic resonance (MR) thermometry. Therefore, FUS demonstrated great potential to sensitize cancer cells to RT in both in vitro and in vivo studies.

The intensive analysis started on in vitro cell cultures using ultrasound penetrable 96-well cell culture plates and different in vitro systems for high throughput FUS treatment which were developed in cooperation with Fraunhofer IBMT (St. Ingbert). Prostate cancer cells, glioblastoma, and head and neck cancer cell lines were treated with FUS and RT using in vitro systems and the effects on metabolic activity, DNA damage, hypoxia, cell invasion, expression of proteins, and long-term clonogenic survival were determined. To validate the in vitro study, an animal experiment was performed using MR-compatible FUS system Diphas (developed by Fraunhofer IBMT) and computed tomography (CT)-guided RT platform in xenograft prostate cancer model in cooperation with Fraunhofer IZI (Leipzig). Follow-up of tumor growth and histological analysis were performed to evaluate the treatment outcome.

The in vitro results demonstrated a significant reduction of cell survival, invasion, and suppression of the growth of cancer cells. The results are in submission for publications. Histology staining of healthy organs demonstrated no damage to surrounding tissues after FUS exposure, confirmed the safety of our in vivo experimental set-up. The combination of FUS and RT led to a significant decrease in proliferation and an increase of apoptosis in prostate xenografts. For the clinical translation of the combined FUS and RT treatment, a system consisting of two Kuka robotic arms, holding an imaging probe and a therapeutic transducer respectively, was developed and evaluated. Robotic arm system with MR-compatible FUS system was successfully integrated into clinical PET-MR scanner allows precise FUS positioning and provide clinical feasibility.
CURE-OP - COMBINATIONAL ULTRASOUND AND RADIOTHERAPY ENHANCED ONCOLOGY PLATFORM

The project CURE-OP aims to prepare a commercially available high intensity focused ultrasound (HIFU) platform specifically designed for combinational cancer therapy. ICCAS will develop a robotic system that can deliver a broad range of ultrasound regimes (hyperthermia, thermal ablation, and cavitation) enabling different types of cancer polytherapy.

A Kuka LBR Med robotic arm was combined with Theracion’s HIFU treatment head. ICCAS is developing motion algorithms to ensure a stable acoustic coupling of the treatment head. Following the integration of the treatment head into the robotic system, an ex-vivo study will be conducted in cooperation with the ENT department of the Leipzig University hospital to validate the system.

IMAGING ROBOTICS

The robotics group at ICCAS aims for the integration of robotic systems into the clinical workflow of image-guided interventions. The main goal comprises the development of a robotic system that provides various functions to serve in multiple different use-cases and, thereby, improve acceptance in the medical domain. Utilizing the KUKA lbr iiwa 7 R800 and Med robotic arms and their collaborative concepts (direct user interaction during automated movement), shall reduce the complexity of handling the robots during surgical workflows. Using the IEEE 11073 SDC standard for medical device connectivity, the ICCAS researchers implemented a first demonstrator with two robot arms. The system communicates with any other SDC medical device and can, thereby, be utilized for many image-based use-cases. It was evaluated for ultrasound-guided biopsies and focused ultrasound ablations during the projects Sono-Ray and Cure-OP.

PREPOSITIONING AVATERA

Under commission by the avateramedical GmbH (https://www.avatera.eu/home), ICCAS is investigating the possibilities to optimize the positioning principles of a novel robotic system for laparoscopic interventions. In cooperation with the urology department of the university clinic Leipzig, the requirements for the pre-positioning of the system at the OR-table were defined and transferred into robotic workspace simulations. The aim of this work is to provide an intuitive procedure for the docking process of the robot at the OR-table and an optimized positioning for the robot arms at the patient for the best possible workspace during the intervention. The simulations were performed with a 3D model of the avatera system, provided by ITK Engineering GmbH (https://www.itk-engineering.de/)
branchen/robotik/), to isolate the best parameters for efficient positioning, including the height of the robot, the docking angle at the OR-Table, the distance to the patient and the work angle of the trocar holders on the patient. In a preliminary investigation, the most reasonable positions were tested on a body phantom, to derive a defined workflow for easy arm positioning and overall robot handling. In consequence, ICCAS developed a guidance manual for the side docking of the system for radical prostatectomies. A user validation with probands of varying expertise is planned for Q1-Q2 2021.

**NON-INVASIVE MAGNETIC – RESONANCE – GUIDED FOCUSED ULTRASOUND (MRGFUS) IN THE TREATMENT OF UTERINE FIBROIDS**

Since 2017, we have successfully established a fibroid-treatment center in our hospital (Leipzig University Hospital). Our aim is to provide an optimized individual treatment to patients with symptomatic uterine fibroids, offering all modern therapy options including MR-g-HIFU (Profound medical Sonalleve MR-HIFU System). To date over 300 patients have been screened and 46 of these became a MR-HIFU-Treatment. The patients were treated in a clinical setting, under analgesia and sedation. All patients were discharged on the next day after treatment without any significant complaints. Symptom control was accomplished for about 2/3 of the patients and 3 successful pregnancies were also achieved. In addition a multisession HIFU-Treatment of an extensive desmoid tumor of the thoraco-abdominal wall has taken place with satisfying symptom reduction.

**NEUROMODULATION USING TRANSCRANIAL ‘LOW INTENSITY FOCUSED ULTRASOUND’ (LIFU) STIMULATION MEASURED WITH EEG**

Previous studies suggested tFUS for non-invasive modulation of neuronal activity, which might allow therapeutic applications. We used a custom-made tFUS system (IBMT) that allows to position a focal ultrasound spot in a given brain volume by adjusting the focus depth. Preliminary data acquired with four scalp electrodes showed a differential modulation of EEG activity depending on the stimulation depths, i.e. alpha synchronization for focus 30 mm, desynchronization for 100 mm. In a second experiment with denser EEG recordings we now confirm these results. It seems that the cortical stimulation (30 mm) synchronizes local neuronal activity leading to increased ongoing oscillations, while the deeper stimulation focus maybe activates thalamic projection neurons thus desynchronizing cortical background rhythms.
RESEARCH AREA: MAGNETIC RESONANCE-GUIDED INTERVENTIONS – MRGI

MR-THROMBOSIS-THERANOSTIC – MR-GUIDED MINIMALLY-INVASIVE DIAGNOSIS AND THERAPY OF THROMBOSSES

Blood clots disturb the physiological blood flow and can become detached as thromboembolism – in worst case migrate and cause a life-threatening pulmonary embolism. In MR-THROMBOSIS-THERANOSTICS the beneficial features of MR imaging (excellent soft tissue contrast, adjustable tissue weighting & real-time imaging) are used to improve interventional thrombosis treatment and theragnostics. These features can be used for visual acquisition of thromboembolisms trapped by implanted vena cava filters (VCF) and therefore lead to better decisions regarding the further course of the treatment. To ensure conformity with regulations regarding MR safety and biocompatibility, novel medical instruments and corresponding workflows need to be developed. The visualisation concept uses resonant circuits to locally enhance the MR signal, rather than the commonly used mechanism of disturbing artefacts caused by shielding properties. A silicone-based patient model of a human arteriovenous vessel system is manufactured. It allows in-vitro testing of devices and workflows in cooperation with the University of Leipzig Medical Center. An attached pulsatile flow pump and integrated thrombus simulation ensure lifelike testing conditions. Additionally, an interventional MRI setup was developed with the Department of Nuclear Medicine, ensuring real time control and communication between physician and technical staff during MR-guided interventions.

MR-BIOPSY – MR COMPATIBLE FLEXIBLE BIOPSY FORCEPS FOR MINIMALLY INVASIVE TISSUE SAMPLING

Endomyocardial biopsy (EMB) is a procedure for diagnosis of tumor, acute myocarditis or transplant rejection. EMB is usually conducted using X-ray fluoroscopy implying ionizing radiation and nephrotoxic contrast agents, implying drawbacks for medical staff and patients. Goal of the joint project MR-BIOPSY is to overcome these disadvantages by transfer of EMB procedures into the magnetic resonance imaging (MRI) environment. Therefore, a worldwide first MR compatible, flexible biopsy forceps containing novel MRI markers is developed. In an iterative process, the MRI visibility of forceps and markers are obtained, while ensuring conformity of components with MR safety regulations like ASTM and ISO standards. Feasibility of the intervention is guaranteed by development of a corresponding clinical workflow in cooperation with the Department of Cardiology of University of Leipzig Medical Center.
Leipzig Medical Center. A hybrid patient model consisting of a porcine heart connected to a life-size silicone model of a human arterial vessel system was manufactured. First prototypes showed promising results in test settings and will be subject to ex-vivo-studies to evaluate the visibility and usability of the forceps and the workflow in a realistic setting.

**MR-STENTS – MR-GUIDED STENT-IMPLANTATION**

Coronary heart disease and associated myocardial infarction is one of the main causes of death in Germany. The recommended therapy by the National Disease Management (NVL) guideline is minimally invasive catheter-guided stent implantation, which is usually performed using X-ray fluoroscopy. As a high risk group, children with congenital heart disease (e.g. coarctation of the aorta) are commonly treated by stent implantation. The aim of project MR-STENTS is to enable a MRI-guided stent intervention by developing MR compatible devices together with OEM medical device manufacturers. Novel MR markers are developed to visualize multiple instruments during an MR-guided stent implantation. These markers are based on resonant circuits and work with corresponding MR sequences. A specially designed MRI-safe stenosis-phantom is manufactured to investigate the visibility and applicability in accompanying tests during the development process. It allows for a realistic simulation of stent implantation and serves as training environment to validate a dedicated workflow for MRI-guided stent implantation. In the further course of the project, the findings should serve as framework for treatment of additional use-cases like stenting of the esophagus, liver, and lung.
Research pioneers the development of biomedical information systems and data analysis technologies, medical communication technologies, digital twins, and biomedical sensors which expand the functioning of current medical devices or create completely new support. Work is in progress on a ‘smart’ operating theater adapted to the needs of surgeons. Goal is the qualitative and quantitative improvement of clinical workflows by advancing clinical efficiency and increasing patient safety. This also includes the development of non-invasive image-based assistance systems for new diagnosis and biomonitoring in emergency medicine.
MODEL-BASED MEDICINE AND INTELLIGENT OR

Modern medicine is no longer conceivable without the use of technology: medicine, information management and biomedical technology converge to an ever greater extent. This development requires a combination of traditional medical devices.

SCIENTIFIC STAFF
Johann Berger, Richard Bieck, Albrecht Bloße, Tom de Hoop, Stefan Franke, Reinhard Fuchs, Jan Gaebel, Christoph Georgi, Johannes Keller, Hannes Köhler, Patrick Kongo, Adrian Lindenmeyer, Ivan Matyash, Tim Meschke, Julia Mrongowius, Juliane Neumann, Alexander Oeser, Tobias Pabst, Annekatrin Pfahl, Max Rockstroh, Dominic Schneider, Erik Schreiber, Gregor Thürk, Mariia Tkachenko

SELECTED PUBLICATIONS


#MODEL_BASED_MEDICINE AND #INTELLIGENT_OR

**SCIENTIFIC RESEARCH AREAS AND RELATED PROJECTS:**

**#MODEL_BASED_AUTOMATION:**
- **MOMENTUM** | Mobile Medical Technology for Integrated Emergency Care and Accident Medicine | Funding: BMBF
- **COMPASS** | Comprehensive Surgical Landscape Guidance System for Immersive Assistance in Minimally-invasive and Microscopic Interventions | Funding: BMBF
- **ENSEMBLE** | Development of a scalable and magnetic resonance (MR)-compatible blood circulation model | Funding: BMWi – ZIM-program

**#DIGITAL_PATIENT_MODEL:**
- **MPM** | Models for Personalized Medicine | Funding: BMBF
- **AQNET** | The medical data ecosystem | Funding: BMWi
- **KAIT** | Knowledge-Driven and Artificial Intelligence-Based Platform for Therapy Decision Support in Hematology | Funding: Janssen Pharmaceutica
- **ProDial** | Patient-Reported Outcome, Biodata and Process Data to Evaluate Dialysis Tolerability | Funding: ERAPerMed
- **PAPA-ARTIS** | Paraplegia Prevention in Aortic Aneurysm Repair by Thoracoabdominal Staging with ‘Minimally-Invasive Segmental Artery Coil-Embolization’: A Randomized Controlled Multicentre Trial | Funding: European Union - H2020 - GA-Nr. 733203

**#LIFE_SUPPORT_SYSTEMS:**
- **VITALS** | Visualization of Thorax-related Analysis of Life-Signals | Funding: BMWi – ZIM-program
- **IMPACT** | Data integration and modeling for improved multiparametric monitoring of blunt thoracic trauma | Funding: BMBF – KMU innovativ
- **Brainsaver** | Development of robust methods for sensor position evaluation and interference-free blood flow detection | Funding: BMWi – ZIM-program
- **AutoCuff** | Software development of a complete medical system consisting of cuff suction device and cuff controller | Funding: BMWi – ZIM-program
The emergency medical care of patients inside and outside the hospital is based on a complex system of interdependent processes involving many different actors (e.g., doctors, paramedics, nurses) as well as a large number of different medical devices and IT systems. Especially the treatment outside of specialized medical facilities (e.g., hospital, community health center, medical office) requires the quick and easy availability of medical resources, smooth access to information as well as the availability of medical expertise.

In the MOMENTUM project, medical technology is being developed that can be used not only in preclinical emergency care at the scene of the accident, but also in the hospital. Heterogeneous technologies of networked medical technology inside an ambulance and IT systems will be integrated into a mobile infrastructure using 5G-technology. As a result, medical-technical resources, technologies and information of the hospital can virtually be used on site and data can be transmitted to the hospital before the patient even arrives there. This not only allows a more precise diagnostic assessment of the patient-specific situation, but also a much higher precision in the initial diagnosis on site. The end-to-end availability of clinical information throughout the entire process chain – from the scene of the accident to the trauma room to the operating theater – can improve patient care and make it more efficient. In addition, the information collected at the scene of the accident and during transport can be coordinated for further treatment and be used seamlessly in the hospital. The availability of a high-performance network enables the distribution of computing power either from the device to the ambulance or directly to the higher-level infrastructure (Mobile Edge Cloud - MEC). The results of the MOMENTUM project should help to set new standards in emergency care. The transmission of relevant information from the site to the hospital allows a new type of supply chain between ambulance and trauma room and enables new kinds of medical applications at the scene of accident and a better preparation in the trauma center.

After an analysis of the use cases at the accident site and in the clinic with all project partners, an overall architecture concept was developed with a strong focus on IT security and flexibility in the used communication technology. First measurements with public 5G mobile cell networks were carried out and the integration of medical technology in the ambulance with the ISO/IEEE11073-SDC standard family was implemented. Furthermore,
the setup of an ambulance with 5G-Small-Cell was planned and will be put into practice next year.

In a next step, the basic communication technology in the ambulance based on a mobile small cell will be implemented. Another use case is the development of mobile and stationary display methods in the clinic and at the accident scene.

**COMPASS – COMPREHENSIVE SURGICAL LANDSCAPE GUIDANCE SYSTEM FOR IMMERSIVE ASSISTANCE IN MINIMALLY-INVASIVE AND MICROSCOPIC INTERVENTIONS**

In the project COMPASS, a new technology for immersive assistance in minimally invasive and microscopic interventions is developed to convert navigation systems into fully acknowledged surgical actors. The goal is to identify, model and predict the surgeon’s navigation process for the provision of assistance functions. The focus is on the development of an artificial navigation awareness for endoscopically guided minimally invasive procedures. The starting point is a machine-understandable description of surgical navigation during inspection of anatomical structures that are visited. Initially, navigation steps were described in natural language (NLP) in order to create an instruction-like commentary on the movement of the endoscope from one navigation step to the next. Then neural machine translation model was trained to predict future navigation steps of the endoscope. We successfully showed that a verbalized description of the endoscope movement could be reproduced. This represents the first step in the implementation of a comprehensible navigation aid through navigation awareness. Further studies will involve computer vision aspects that use the provided description mechanism to improve classification functions to better locate the endoscope. Additionally, computed image properties will also reinforce sentence descriptions.

**ENSEMBLE – DEVELOPMENT OF A SCALABLE AND MAGNETIC RESONANCE (MRI) COMPATIBLE BLOOD CIRCULATION MODEL**

Artificial surgical phantoms enable surgeons to improve their skills and dexterity outside of real surgeries. For the training of catheter-based surgeries, a training model with a realistic vascular tree and an active blood circulatory system is required. In the project ENSEMBLE such a phantom was developed, by using CT images and automatically segmented blood vessel areas throughout combined data sets. The phantom should represent the density, thickness, and elasticity of real vessel walls with a maximum degree of branching. Together with a pump and a blood-like fluid, the vascular 3D model was used to manufacture
The project Models for Personalized Medicine develops multimodal knowledge graphs, machine learning methods, and applications to assist cancer treatment workflows.

The focus of the project was the development of an automatic segmentation procedure by means of statistical form models. For this purpose, semi-automatically segmented CT-images were used as training data. These were represented by surface landmarks that were transformed into a common coordinate system. With the Iterative Closest Point (ICP) algorithm, corresponding landmarks were detected, and a 3D shape model could be generated considering the typical shape of the aorta (statistical mean). During automatic segmentation, the shape model was adapted to the specific variations of the aortas’ shape in the actual patient-specific image data. The resulting aorta 3D-representation was then used to manufacture an artificial, scalable and MR conditional blood circulation model for surgical training.

**RESEARCH AREA: DIGITAL PATIENT MODEL – DPM**

**MPM – MODELS FOR PERSONALIZED MEDICINE**

Healthcare is changing due to social challenges in the area of tension between cost efficiency through standardization and therapy effectiveness through personalization. Therapy-relevant information, for example in interdisciplinary, oncological treatment, covers the entire range from omics data, imaging, and laboratory values to the inclusion of living conditions. For efficient healthcare, the data must be available in daily clinical practice and decision support systems must seamlessly integrate into established clinical workflows.

The aim of the project is, therefore, to create a scientific and methodological basis for model-based, personalized cancer treatments that can be used in a large variety of clinical settings. The project addresses scientific questions in the field of knowledge modeling and data semantics. Clinical knowledge, such as guidelines, scoring systems and studies, is translated into formal models. The overall modular architecture of our approach enables the combination of a large variety of methods and formal models of general medical knowledge. For individual patients, related data are represented in a knowledge graph based on the Resource Description Framework (RDF). Within this graph, semantics is maintained by a set of established and newly developed ontologies. The data representation also references clinical reports and information systems, such as Patient Data Management Systems (PDMS) or Picture Archiving and Communication Systems (PACS). The patient-related information is maintained by software, called Digital Medical Twin. Ba-
sed on the formalized clinical knowledge and the interlinked patient data, it can provide multimodal analyses, data-based predictions, or risk warnings to provide reasoned evidence to complex clinical questions via this novel data interface.

The developed models and the data interface serve as a basis for applications for personalized tumor therapy. So that we can provide a common understanding of work processes, patient data and decision-making processes as the basis for integration into clinical practice. The complexity of medical data and clinical processes requires the development of tailored applications for the respective clinical scenarios and user groups along the tumor treatment chain. For example, the project assists interdisciplinary therapeutic decisions for cancer patients with an intelligent environment for the cooperative clinical decision making. Additionally, an assistance system is developed for the improvement of patient informed consent to treatment measures by interactive, personalized illustrations of the tumor and the potential treatment risks.

The project demonstrates the applicability and added value of selected assistance systems as well as the integration of these applications based on interoperable models in cooperation with regional SME partners and the clinical users.

**AIQNET – THE MEDICAL DATA ECOSYSTEM**

Due to the new Medical Device Regulation of the EU, the requirements for reliable medical device data are continuously increasing. To prove their continuous safety and performance, a market observation of the products based on clinical studies is explicitly required, which also includes a comparative quality and performance evaluation. The acquisition, storage, and analysis of clinical data in compliance with the data protection regulations are essential for this evaluation. Therefore, AIQNET a medical data ecosystem that ensures compliance with legal and ethical frameworks through state-of-the-art architecture and security technologies will be conceptualized and developed in the project. Within the framework of the platform, a database will be created, which enables both the clinics and medical device manufacturers to use clinical data for research and development effectively and in compliance with the EU regulatory framework.

In cooperation with the University Hospital Leipzig, Division of Spine Surgery, ICCAS will develop a “Digital Patient Model”. The model integrates different perspectives on treatment and the patient. The aim is to improve AI-supported clinical quality and performance assessment based on previous knowledge about the patient and the treatment. This
Holistic data gathering of hemodialysis therapy procedures enables the data-driven analysis of various synchronized biomedical data streams to find meaningful correlations for better patient-specific outcome and risk predictions.

includes aspects of diagnosis and the disease, information on therapies and the specific characteristics of the patient.

**KAIT – KNOWLEDGE-DRIVEN AND ARTIFICIAL INTELLIGENCE-BASED PLATFORM FOR THERAPY DECISION SUPPORT IN HEMATOLOGY**

The medical field of hematology is characterized by heterogeneous diseases and considerably varying patient disease courses. Nonetheless, therapeutic decisions mostly rely on the administration of the same therapeutic regimen to this utterly diverse patient population. Due to the continuous effort of providing personalized medicine in various clinical fields, there’s now more patient and disease data available than ever before. While this is a truly desirable situation, considering all that information during clinical decision-making introduces real challenges for the physicians. To overcome the flaws of this potential information overload, the KAIT platform aims to provide extensive assistance in the way that clinical data is managed, processed and represented. The system will utilize methods of knowledge engineering, data mining and machine learning to gather, evaluate and analyze multimodal information from medical case reports, clinical trial data, research publications as well as clinical practice guidelines to generate extensive knowledge bases. Through data-driven approaches, the system will then actively assist the physician during reasoning tasks to derive optimal treatment strategies for each individual patient. KAIT thus supports the transformation towards truly personalized therapies in hematology.

**PRODIAL - PATIENT-REPORTED OUTCOME, BIODATA AND PROCESS DATA TO EVALUATE DIALYSIS TOLERABILITY**

While haemodialysis treatment affects only 0.1% of the total population, it requires 5 to 10% of the total health care costs in industrialized countries. Although the complex and long-term treatment ensures life-sustaining detoxification, it does not prevent 5 to 10 times higher mortality of affected end-stage renal disease patients compared to the general population. Current quality and process control measures of hemodialysis treatment are based on a general evaluation of biochemical and procedural measures that do not take into account the patient perspective in terms of mortality and dialysis tolerance. To address this issue, the ProDial project aims to develop methods for the individual analysis of dialysis treatments. Therefore, time-synchronous data streams of various treatment aspects will be gathered and evaluated. This includes patient and therapy characteristics, biomedical real-time feedback, process information and patient reported outcomes (PRO). Based on this collection, novel mechanisms for finding significant correlations between the referenced data categories enable the development of personalized real-time dialysis
treatment procedures in the long-term. These data-based algorithms can then be integrated into modern and intelligent dialysis centers to enable truly personalized real-time treatment monitoring and risk prevention.

PAPA-ARTIS – PARAPLEGIA PREVENTION IN AORTIC ANEURYSM REPAIR BY THORACOABDOMINAL STAGING WITH ‘MINIMALLY-INVASIVE SEGMENTAL ARTERY COIL-EMBOLIZATION’: A RANDOMIZED CONTROLLED MULTICENTRE TRIAL

The repair of large thoracoabdominal aortic aneurysms employs endovascular surgery with stent grafting. A successful intervention still poses risks of paraplegia or death due to ischaemic reactions in the spinal cord. In a new procedure supplying segmental arteries of the aorta are preemptively closed to counter ischemic effects. Inside the multi-centric clinical PAPA_Artis EU project, the patient is computationally modelled to investigate the spinal perfusion and the clinical outcome. We aim to generate a patient-specific representation of the treatment process. Main patient parameters like demographics and imaging data were analysed using workflow analysis steps. The patient model is later used to form a therapy model for the PAPA_Artis EU clinical trial.

RESEARCH AREA: LIFE SUPPORT SYSTEMS – LSS

VITALS - VISUALIZATION OF THORAX-RELATED ANALYSIS OF LIFE-SIGNALS

The project VITALS is a follow-up project of IMPACT. The aim of the project is to develop a system for preclinical emergency use, which can measure and visualize lung and heart activity simultaneously. For this purpose, a device is to be developed that enables Electrical Impedance Tomography (EIT) and Electrocardiography (ECG) using the same sensor technology. The subsequent combination can be used to separate the small perfusion-related impedance changes of EIT-images from high-value ventilation-related impedance changes. The resulting perfusion map can be used for further analysis, e.g. Ventilation-Perfusion-Overlap. In the case of existing oxygenation problems, first statements about the cause and accompanying conclusions about respiratory or vascular-relevant problems can thus be made.

IMPACT - DATA INTEGRATION AND MODELING FOR IMPROVED MULTIPARAMETRIC MONITORING OF BLUNT THORACIC TRAUMA

The Goal of IMPACT was to develop a mobile lung monitoring system for preclinical emer-
emergency use. With the help of the system, medical staff should be able to visualize pulmonary ventilation of a patient with a non-invasive, radiation-free and location-independent method. The monitoring analysis is based on the technique of electrical impedance tomography. ICCAS part of the project was to develop and implement the analysis algorithms for lung monitoring. Their main components were methods for instantaneous, patient-specific EIT-reconstructions that don’t require an explicit baseline. Furthermore, developers implemented analysis algorithms, to enable the verification of spontaneous ventilation in both lungs and show whether the ventilation tube was placed correctly. Independently from those issues, other functions allow the detection and visualization of the presence, location and size-changes of existing pneumothoraces. After completion of the project, the developments were taken over by the company Fritz Stephan and are now in the transfer to product maturity.

**BRAINSAVER - DEVELOPMENT OF ROBUST METHODS FOR SENSOR POSITION EVALUATION AND INTERFERENCE-FREE BLOOD FLOW DETECTION**

In Germany, at least 50,000 people require reanimation every year, but only about 10% of patients who have received cardiopulmonary resuscitation (CPR) leave the clinic with acceptable neurological results. In the course of this project, a mobile system is to be developed that can be used to measure the blood-flow in the brain vessels during CPR. This in turn shall enable an evaluation about the effectiveness of the compressions and a real-time feedback on the performed resuscitation activity. Further evaluation of automatically logged data can be analyzed during the following therapy and enables clinicians to adjust medication, coordinate therapy and identify patients with higher neural damage risk.

**AUTOCUFF - SOFTWARE DEVELOPMENT OF A COMPLETE MEDICAL SYSTEM CONSISTING OF CUFF SUCTION DEVICE AND CUFF CONTROLLER**

The aim of the AutoCuff project is the development of a system for automatic secretion removal and pressure control for a cuff balloon. In intubated, long-term ventilated patients, foreign matter and secretions above the occluding cuff balloon are removed using cuff suction devices. However, the mutual influence of the balloon overpressure and negative pressure for removal can lead to tissue damage or leakage. For this purpose, the project will develop a combination device that controls both pressure control loops simultaneously. By means of an interoperable interface, external medical devices will be notified in selected scenarios to communicate alarms and warnings.
LEAD
PROF GALINA IVANOVA

SCIENTIFIC STAFF
Till Handel, Max Schreiber, Jean-Baptiste Tylc

PROJECT
• PostStroke | Mobile, digital system to strengthen relapse prevention, health competence and self-reliance | Funding: Freistaat Sachsen-eHealthSax

SELECTED PUBLICATIONS


POSTSTROKE MANAGER: MOBILE, DIGITAL SYSTEM TO STRENGTHEN RELAPSE PREVENTION, HEALTH COMPETENCE AND SELF-RELIANCE

The Research Group Biomedical Data Analysis is dedicated to the development of new methods and tools for the investigation of complex biomedical processes and systems.

It unifies know-how in the areas of designing algorithms, analytical pipelines and modelling of complex biomedical processes as well as the efficient software implementation and finally the integration into various diagnostic, therapeutic and preventive applications.

Our know-how ranges from the design of studies, the support of data acquisition, the analysis of large amounts of data and the development of individualized methodologies and software to the preparation of demonstrators and prototypes which can be transferred into marketable products.

The fields of medical algorithms, multimodal neuroimaging as well as mHealth and eHealth are a special focus of the group.

https://www.iccas.de/poststroke/
# INTRAOPERATIVE MULTIMODAL IMAGING

## LEAD
PD DR CLAIRE CHALOPIN

## SCIENTIFIC STAFF
Hannes Köhler, Marianne Maktabi, Michael Unger

## PROJECTS
- **LYSIS | Development of a Laparoscopic Hyperspectral Imaging System | Funding:** BMBF- KMU innovativ
- **SORLIC | Development of an Assistance System for the Intra-Operative Planning of Flap Surgeries | Funding:** BMBF- KMU innovativ
- **MSI | Endoscope- Endoscopic Multispectral Imaging with Real Time Pulse Oximetry System for Medical Applications | Funding:** Karl Storz SE & Co. KG
- **HSI | Laparoscopy: Automated tissue recognition and visualisation with laparoscopic hyperspectral imaging | Funding:** Karl Storz SE & Co. KG

## SELECTED PUBLICATIONS

## LYSIS - DEVELOPMENT OF A LAPAROSCOPIC HYPERSPECTRAL IMAGING SYSTEM

Hyperspectral imaging (HSI) is a contactless and non-invasive optical imaging method which showed promising results for applications in the surgery. The goal of this project performed in collaboration with the company Diaspective Vision GmbH is the development and clinical evaluation of a HSI laparoscopic system and computer-assisted approaches to automatically identify tissues and organs in minimal-invasive operations.

The LYSIS prototype developed by Diaspective Vision was technically evaluated at ICCAS. It is the first system with high spatial and spectral resolutions and simultaneous color video. The first acquisition of fresh resected tissue was performed at
the hospital. Moreover, approaches using Machine Learning and Deep Learning methods for automatic tissue identification were developed and firstly evaluated on HSI data acquired with an HSI system dedicated to open surgeries. Different medical applications were investigated: the discrimination of the parathyroid gland and bile duct from surrounding tissue in in vivo HSI data and the recognition of cancer cells in HSI histological slides of tissue probes of Barrett’s tumor. The next step of the project is the integration of the functionalities for automatic tissue identification with the software of the LYSIS system and the evaluation of the prototype in the operating room on resected tissue.

**SORLIC - DEVELOPMENT OF AN ASSISTANCE SYSTEM FOR THE INTRA-OPERATIVE PLANNING OF FLAP SURGERIES**

The aim of project SORLIC is the development of a system to assist during the planning of free flap transplantation in reconstructive surgeries. These surgeries require knowing the positions of the blood vessels supplying the donor tissue. Conventional imaging techniques use ionizing radiation and/or contrast agents (angio CT/MRI, ICG angiography, or DSA). As a non-invasive alternative, infrared thermography will be used to detect the blood vessels supplying the donor tissue. A tool will be developed to support the surgeon during the planning of the procedure. Furthermore, the blood vessels and the planning results will be visualized using augmented reality.

**MSI ENDOSCOPE – ENDOSCOPIC MULTISPECTRAL IMAGING WITH REAL TIME PULSE OXIMETRY SYSTEM FOR MEDICAL APPLICATIONS**

In recent years, spectral imaging methods have been introduced into the clinical field for perfusion imaging and tissue classification. New hyperspectral systems providing high spectral and spatial resolution have been investigated in the research. Due to low temporal resolution and complex setups, their usage in minimally-invasive procedures is limited. Therefore, a flexible endoscope for real-time pulse oximetry based on multispectral imaging is devised in this project. KARL STORZ SE & Co KG, Diaspective Vision GmbH, and the ICCAS are cooperation partners. The tasks of ICCAS are the development and visualization of new pulse oximetry parameters and the conduction of pre-clinical and clinical trials with medical partners.

**HSI – LAPARO/ENDOSCOPY: AUTOMATED TISSUE RECOGNITION AND VISUALISATION WITH LAPAROSCOPIC HYPERSPECTRAL IMAGING**
Hyperspectral imaging (HSI) can support intraoperative perfusion assessment, the identification of tissue structures, and cancerous lesions. The practical use of HSI for minimal-invasive surgery is currently limited, due to missing video, or large set-ups. To address these limitations, compact and rapid laparoscopic HSI with a high spatial- and spectral-resolution is currently developed in the LYSIS project.

This project aims to acquire and analyse HSI data with the new laparoscopic HSI-system in the clinical context. Methods for the registration of the HSI data with the colour videos and automated, intraoperative classification of tissue with hyperspectral data will be developed and evaluated. The resulting information will be visualised using augmented reality methods.
FIRST- AND SENIOR AUTHORSHIP
Contrast reflux into the inferior vena cava on computer tomographic pulmonary angiography is a predictor of 24-hour and 30-day mortality in patients with acute pulmonary embolism. Acta Radiol 2020; (): 284185120912506 ISSN 0284-1851

Bieck R, Heuermann K, Pirlich M, Neumann J, Neumuth T

Cao R, Huang Z, Nabi G, Melzer A

Requirements for 5G Integrated Data Transfer in German Prehospital Emergency Care. Current Directions in Biomedical Engineering 2020; 6 (3): 9-12 ISSN 2364-5504

Modeling and processing up-to-dateness of patient information in probabilistic therapy decision support. Artif Intell Med 2020; 104: 101842 ISSN 0933-3657

Individualised positive end-expiratory pressure guided by electrical impedance tomography for robot-assisted laparoscopic radical prostatectomy: a prospective, randomised controlled clinical trial.
Br J Anaesth 2020; 125(3): 373-382
ISSN 0007-0912

[Possibilities and perspectives of hyperspectral imaging in visceral surgery].
Chirurg 2020; 91(2): 150-159
ISSN 0009-4722

Hyperspektral-Imaging (HSI) ? eine verlässliche Gewebedifferenzierung?
Zentralbl Chir 2020; 145(2): 125-129
ISSN 0044-409X

Hu S, Zhang X, Unger M, Patties I, Melzer A, Landgraf L
Focused Ultrasound-Induced Cavitation Sensitizes Cancer Cells to Radiation Therapy and Hyperthermia.
Cells 2020; 9(12): 2595
ISSN 2073-4409

Laparoscopic system for simultaneous high-resolution video and rapid hyperspectral imaging in the visible and near-infrared spectral range.
J Biomed Opt 2020; 25(8): 086004
ISSN 1083-3668

Semi-automatic decision-making process in histopathological specimens from Barretts carcinoma patients using hyperspectral imaging (HSI)
Current Directions in Biomedical Engineering 2020; 6 (3): 261-3
ISSN 2364-5504
Classification of hyperspectral endocrine tissue images using support vector machines.
Int J Med Robot 2020; (): e2121
ISSN 1478-5951

Mihcin S, Gagliardo C, Toia P, Dennison A, Strehlow J, Melzer A
MR-guided focused ultrasound application for moving target tumor ablation in abdominal area: coil selection.
Acta Radiol 2020; (): 284185120914059
ISSN 0284-1851

Müller J, Stoehr M, Oeser A, Gaebel J, Streit M, Dietz A, Oeltze-Jafra S
A visual approach to explainable computerized clinical decision support.
Computers & Graphics 2020; 91: 1-11
ISSN 0097-8493

Neumann J, Angrick C, Höhn C, Zajonz D, Ghanem M, Roth A, Neumuth T
Surgical workflow simulation for the design and assessment of operating room setups in orthopedic surgery.
BMC Med Inform Decis Mak 2020; 20(1): 145
ISSN 1472-6947

Towards an integrated emergency medical care using 5G networks.
Current Directions in Biomedical Engineering 2020; 6 (3): 5-8
ISSN 2364-5504

Unger M, Berger J, Gerold B, Melzer A
Robot-assisted Ultrasound-guided Tracking of Anatomical Structures for the Application of Focused Ultrasound.
Current Directions in Biomedical Engineering 2020; 6(3): 20203032
ISSN 2364-5504

CO-AUTHORSHIP
Comparison of hyperspectral imaging and fluorescence angiography for the determination of the transection margin in colorectal resections-a comparative study.
Int J Colorectal Dis 2020; (): 0-00
ISSN 0179-1958
Li G, Patel NA, Melzer A, Sharma K, Iordachita I, Cleary K
MRI-guided lumbar spinal injections with body-mounted robotic system: cadaver studies.
Minim Invasive Ther Allied Technol 2020; (): 1-9
ISSN 1364-5706

Lorenz N, Sander C, Ivanova G, Hegerl U
Temporal Associations of Daily Changes in Sleep and Depression Core Symptoms in Patients Suffering From Major Depressive Disorder: Idiographic Time-Series Analysis.
JMIR Ment Health 2020; 7(4): 17071
ISSN 2368-7959

Hyperspectral Imaging (HSI) in Acute Mesenteric Ischemia to Detect Intestinal Perfusion Deficits.
J Surg Res 2020; 254: 7-15
ISSN 0022-4804

[Ablative treatment options for locally advanced unresectable and borderline resectable pancreatic carcinoma].
Chirurg 2020; 91(4): 319-328
ISSN 0009-4722

[Hybrid esophagectomy with intraoperative hyperspectral imaging : Video article].
Chirurg 2020; 91(Suppl 1): 1-12
ISSN 0009-4722

Sucher R, Sucher E, Köhler H, Schoenherr T, Gockel I, Branzan D
Hyperspectral Imaging of the Carotid Artery Subject to Endarterectomy.
Eur J Vasc Endovasc Surg 2020; 60(4): 634-635
ISSN 1078-5884

Obtaining Patient-Reported Outcomes Electronically With „OncoFunction“ in Head and Neck Cancer Patients During Aftercare.
Front Oncol 2020; 10: 549915
ISSN 2234-943X
CONFERENCE PROCEEDINGS

Berger J, Keller J, Unger M, Landgraf L, Melzer A. A Collaborative and Integrated Robotic System for the Application in Image-Guided Interventions. 54th Annual Conference of the German Society for Biomedical Engineering (BMT); 2020.


Pfahl A. Acquisition of Clinical Workflow of EMB for Development of Computer-assisted MRI-guided Interventions. 54th Annual Conference of the German Society for Biomedical Engineering; 2020 Sep 29; Leipzig.

Reich CM. Developing an Intuitive and Feasable Setup for In-room Control During MRI-guided Interventions. 32nd Annual 2020 SMIT Congress; 2020 Dez 3; Leipzig.

Reich CM. Developing an Intuitive and Feasable Setup for In-room Control During MRI-guided Interventions. 54th Annual Conference of the German Society for Biomedical Engineering; 2020 Sep 30; Leipzig.

Reich CM. New MR instruments and ancillary systems for MR guided procedures. 54th Annual Conference of the German Society for Biomedical Engineering; 2020 Sep 30; Leipzig.


Unger M, Berger J, Gerold B, Melzer A. Robot-assisted Ultrasound-guided Tracking of Anatomical Structures for the Application of Focused Ultrasound. 54th Annual Conference of the German Society for Biomedical Engineering (BMT); 2020.

Zhang X, Hu S, Patties I, Landgraf L, Melzer A. Radiosensitization of human cancer cells with in vitro focused ultrasound. 54th Annual Conference of the German Society for Biomedical Engineering (BMT); 2020.

EVENTS

IN-HOUSE EVENTS

ICCAS STATUS SEMINAR AND ADVISORY BOARD MEETING 2020
January 22, 2020 | ICCAS
Demonstrations at seven ICCAS stations on the overarching project topics: Imaging Robotics, MR-Guided Interventions, Medical Technology Networking, Imaging Techniques in Trauma and Visceral Surgery, Cancer Cell Sensitization and Digital Therapy recommendations.

VISIT FROM REPRESENTATIVES OF THE TOWN COUNCIL LEIPZIG
January 24, 2020 | ICCAS
• Reinhard Fuchs | Demonstration in Medical Robotics
• Stefan Franke | Demonstration at the Intelligent OR
• Jan Gaebel | Demonstration of the Digital Patient Model
• Marianne Maktabi | Demonstration in Hyperspectral imaging

16th MEFALE (MEIN FERIENABENTEUER LEIPZIG) 2020
February 13, 2020 | ICCAS
• Marianne Maktabi | Demonstration in Hyperspectral Imaging
• Johann Berger | Demonstration in Medical Robotics
**#EVENTS**

**DGBMT BOARD MEETING**
September 28 | ICCASBiotechnological & Biomedical Center (BBZ), Leipzig & virtual
- Stefan Franke | Presentation of the Intelligent OR, ICCAS
- Johann Berger | Demonstration in Medical Robotics, ICCAS
- Andreas Melzer, Thomas Neumuth | BMT 2020 Board Meeting, BBZ & virtual

**Status Seminar of the Department of Otolaryngology, Head and Neck Surgery of the University**
Hospital Leipzig and ICCAS
December 1 | virtual
Albrecht Bloße, Claire Chalopin, Stefan Franke, Jan Gaebel, Thomas Neumuth, Max Rockstroh

**CONFERENCES, SYMPOSIA, WORKSHOPS**

**WINTER MEETING OF THE EUROPEAN ASSOCIATION FOR ENDOSCOPIC SURGERY (EAES)**
January 24, 2020 | Krakow, Poland
- Andreas Melzer | Cooperation talks

**DGBMT BOARD MEETING**
January 28-29, 2020 | Frankfurt
- Andreas Melzer, Thomas Neumuth | the organization of BMT 2020 in Leipzig and discussion of the program for the conference

**INNOSPACE-CONFERENCE „RAUMFAHRTTECHNOLOGIEN UND -DIENSTLEISTUNGEN FÜR DIE GESUNDHEITSWIRTSCHAFT“**
February 5, 2020 | Stuttgart
- Andreas Melzer | Representation of ICCAS

**SENIOR CITIZENS’ ACADEMY OF THE UNIVERSITY LEIPZIG (SENIORENAKADEMIE DER UNIVERSITÄT LEIPZIG)**
March 3, 2020 | Leipzig
- Thomas Neumuth | lecture: Digitalisierung in der Medizin

**EUROPEAN ROBOTICS FORUM (ERF) 2020**
March 3, 2020 | Malaga
- Andreas Melzer | lecture: The application potential of robotics for image-guided therapy and focused ultrasound to support minimally and non-invasive interventions

**CARS 2020 COMPUTER ASSISTED RADIOLOGY AND SURGERY 34TH**
June 23 – 27, 2020 | Munich, virtual
- Andreas Melzer | Session chair: Robot-assisted Image-guided Therapy
- Thomas Neumuth | Session chair: Imaging Informatics – Advanced Processing; Image-guided Interventions and Therapy
• Johann Berger, Michael Unger, Andreas Melzer | lecture: Development of an integrated robotic dual-arm system for image-guided interventions
• Richard Bieck | lecture: Language-based translation and prediction of surgical navigation steps for endoscope tracking in minimally-invasive surgery
• Julianne Neumann | lecture: BPMNSIX.io - a web-based surgical workflow modeling tool with ontology integration

28TH INTERNATIONAL CONGRESS OF THE EUROPEAN ASSOCIATION FOR ENDOSCOPIC SURGERY (EAES)
June 24 – 27, 2020 | virtual
• Andreas Melzer | online class: Ultrasound for Surgeons

JOINT RESEARCH WORKSHOP ON ARTIFICIAL INTELLIGENCE (AI) TECHNOLOGIES BETWEEN THE GERMAN FEDERAL MINISTRY OF ECONOMICS AND ENERGY (BMWI) AND THE FRENCH MINISTRY FOR EUROPE AND FOREIGN AFFAIRS (MEF)
July 3, 2020 | virtual
• Thomas Neumuth | impulse talk: Potential of Artificial Intelligence (AI) in healthcare

6TH INTERNATIONAL (ONLINE) SUMMER SCHOOL ON AI AND BIG DATA
July 7-8, 2020 | virtual
• Thomas Neumuth | lecture: AI applications in oncology

JOINT VIRTUAL MEETING OF THE AMERICAN AND CANADIAN ASSOCIATIONS OF PHYSICISTS IN MEDICINE (AAPM | COMP)
July 12 – 16, 2020 | virtual
• Andreas Melzer | invited lecture: Molecular Imaging (PET and MRI) guided Focused Ultrasound, a potential future application?

EUROPEAN CONGRESS OF RADIOLOGY (ECR) 2020
July 15 – 19, 2020 | virtual
• Andreas Melzer | Representation of ICCAS

LAUNCH MEETING OF INNOSPACE-NETWORK SPACE2HEALTH INITIATIVE
September 2, 2020 | virtual
• Andreas Melzer | Member of the Steering Committee on the Translation of Medical Technology for Deep Space Missions

51. ANNUAL MEETING OF THE GERMAN SOCIETY FOR MEDICAL PHYSICS (DGMP) 2020
September 9 – 12, 2020 | virtual
• Andreas Melzer | Head of the Joint DGMP Guest Session on the Challenges of MR-guided Interventions from a physical and technical point of view
• Johann Berger | Live robotic presentation
#EVENTS

**GERMAN SOCIETY OF MEDICAL PHYSICS DGMP ANNUAL CONFERENCE**
September 9 – 11, 2020 | virtual
- Andreas Melzer chair of the DGBMT special Session and Invited Lecture

**19TH ANNUAL MEETING OF THE GERMAN SOCIETY FOR COMPUTER- AND ROBOT-ASSISTED SURGERY (CURAC) 2020**
September 17 – 19, 2020 | virtual
- Gary Sean Cooney | Comparison of SSpectral Characteristics in Human and Pig Biliary System with Hyperspectral Imaging (HSI)

**54TH ANNUAL CONFERENCE OF THE GERMAN SOCIETY FOR BIOMEDICAL ENGINEERING (BMT 2020)**
September 29 – October 1, 2020 | virtual
- Andreas Melzer, Thomas Neumuth | Congress Chairmen; Conference Opening & Closure; speech about DGBMT Fellow and 15 Years ICCAS
- Andreas Melzer | keynote chair: Ultrasound-Neuromodulation; What can BME do for Deep Space Mission? ; Organspende und Organersatzverfahren; lectures: MR guided Focused Ultrasound for moving Organs; 3D Printing for Respiratory Support System; session chair: Imaging; Medical robotics; Panel MDR
- Thomas Neumuth | keynote chair: AI in Medicine; panel chair: Panel Artificial Intelligence; session chair: 5G in Medicine; Modelbased Personalised Medicine
- Stefan Franke | session chair: Modelbased Personalised Medicine
- Denis Gholami Bajestani | poster: Development of in-vitro Vessel Phantom for Computer-assisted MRI-guided Thrombectomy and Vena Cava Filter Implantation
- Johann Berger | lecture: A Collaborative and Integrated Robotic System for the Application in Image-Guided Interventions
- Jan Gaebel | lecture: Requirements for 5G Integrated Data Transfer in German Prehospital Emergency Care
- Marianne Maktabi | lecture: Semi-automatic decision-making process in histopathological specimens from Barrett’s carcinoma patients by Hyperspectral imaging (HSI)
- Annekatrin Pfahl | poster: Acquisition of Clinical Workflow of EMB for Development of Computer-assisted MRI-guided Interventions
- C. Martin Reich | lecture: New MR instruments and ancillary systems for MR guided procedures
- C. Martin Reich & Michael Unger | lecture: Developing an Intuitive and Feasible Setup for In-room Control During MRI-guided Interventions
- Max Rockstroh | lecture: Towards an integrated emergency medical care using 5G networks
- Upasana Roy | lecture: Magnetic resonance imaging-guided thermal Therapy with Focused Ultrasound in Preclinical MRI
- Michael Unger | lecture: Robot-assisted Ultrasound-guided Tracking of Anatomical Structures for the Application of Focused Ultrasound
- Xinrui Zhang | lecture: Radiosensitization of human cancer cells with in vitro focused ultrasound
**REGIONS4PERMED: “PERSONALISING HEALTH INDUSTRY” CONFERENCE**

October 15 – 16, 2020 | virtual

- Thomas Neumuth | Member of the Advisory Board

**32ND ANNUAL CONFERENCE OF THE INTERNATIONAL SOCIETY FOR MINIMALLY INVASIVE THERAPY: SMIT 2020**

December 03 – 10, 2020 | virtual

- Andreas Melzer | General Secretary iSMIT | invited lecture: MRgFUS technology
- Denis Gholami Bajestani | presentation: Development of in-vitro Vessel Phantoms for MRI-guided Interventions
- C. Martin Reich | presentation: Developing an Intuitive and Feasible Setup for In-room Control During MRI-guided Interventions
- Michael Unger | presentation: Robot-assisted Ultrasound-guided Tracking of Anatomical Structures for the Application of Focused Ultrasound

**PRESENTATIONS AT FAIRS**

**16. LEIPZIG RESEARCH FESTIVAL OF LIFE SCIENCES**

January 30, 2020 | Leipzig

- Priya Giri | poster: The hyperspectral imaging patient data management and analysis framework HSIdb
- Shaonan Hu | poster: In vitro effects of cavitation induced by focused ultrasound in prostate cancer cells
- Marianne Maktabi | poster: Classification of Barrett’s carcinoma specimens by hyperspectral imaging
- Annekatrin Pfahl | poster: Analysis and development of clinical workflow for minimally invasive magnetic resonance (MR) – guided interventions

**72ND ANNUAL CONGRESS OF THE GERMAN SOCIETY OF UROLOGY (DGU): POST-BEST-OF DGU 2020**

September 29 – October 29, 2020 | virtual

- Andreas Melzer | Session chair “Urology 2030”; invited BMT Lecture: Modern radiology – already a one-stop-shop?

**EUROPEAN COLORECTAL CONGRESS 2020**

November 29 – December 2, 2020 | virtual

- Marianne Maktabi | presentation: Detection of tumor movements, preliminary studies
# EVENTS

## PROJECT- AND COOPERATION WORK

### SDC IMPLEMENTATION MEETING
January 16, 2020 | Lübeck
- Max Rockstroh | Meeting of OR.NET partners

### KUNSTLICHE INTELLIGENZ FÜR KLINISCHE STUDIEN (KIKS) – PROJECT KICK-OFF MEETING
January 21, 2020 | Stuttgart
- Thomas Neumuth, Julianne Neumann | Specifying ICCAS’ contribution through the sub-project AI-QNET

### MAGNETIC RESONANCE (MR) KICK-OFF MEETING
January 22, 2020 | Leipzig
- Andreas Melzer | Defining the research concept for Leipzig site

### MODELS FOR PERSONALIZED MEDICINE KICK-OFF MEETING
March 2, 2020 | ICCAS
- MPM-Group | Meeting of project partners and project aim declarations

### 5G_EHEALTHSAX PROJECT MEETING
March 5, 2020 | Leipzig
- Thomas Neumuth | Presentation of the MOMENTUM project

### TRIMODAL 5G PIONEER REGION LEIPZIG NORTH (TRI5G)-PROJECT EVENT AT BMW PLANT
May 14, 2020 | Leipzig
- MOMENTUM Project team | Presentation: Current research on emergency care using mobile medical technology in interaction with public 5G and campus networks

### PROJECT LYSIS – MILESTONE MEETING WITH DIASPECTIVE VISION & THE ASSOCIATION OF GERMAN ENGINEERS (VDI)
June 8, 2020 | online
- LYSiS-Group | Presentation of the project’s progress thus far and discussion on its following stages

### MR-STENTS MID-TERM MILESTONE MEETING WITH PROJECT PARTNERS
June 9, 2020 | online
- MR-Stents-Group | Discussion of the project’s standings midway its running time

### SONO-RAY-STATUSSEMINAR
June 18, 2020 | online
- Andreas Melzer | ICCAS’ final report
- Xinrui Zhang | Presentation on the Thermal and Mechanical Effects of Focused Ultrasound on Cancer Cells – in vitro and in vivo
• Upasana Roy | Platform for Preclinical MRI-Guided Thermal Therapy with Focused Ultrasound in 7 Tesla MRI
• Johann Berger | An Integrated Robotic System for Focused Ultrasound Radiation Therapy

**MR-TROMBOSE – MILESTONE MEETING**  
July 23, 2020 | online  
• MR Group | Presentation of the project’s progress thus far

**BRAINSAVER PROJECT KICK-OFF MEETING**  
September 9, 2020 | ICCAS  
• Brainsaver Team | Meeting of project partners and project aim declarations

**LERNENDE SYSTEME: ANNUAL MEETING OF WORKING GROUP 6: HEALTH CARE, MEDICAL TECHNOLOGY, CARE**  
September 24, 2020 | online  
• Thomas Neumuth | Member

**OR.NET E.V. ANNUAL GENERAL MEETING**  
November 11, 2020 | online  
• Thomas Neumuth & Max Rockstroh | Meeting

**PROJECT KAIT SC MEETING**  
November 17, 2020 | online  
• KAIT Project Partners | Discussion of the project topics
**LEIPZIG UNIVERSITY**

*Computer Assisted Surgery*
Faculty of Mathematics and Computer Science
practical course

*Development of Medical Products*
Faculty of Mathematics and Computer Science
lecture

*Introduction to Computer Assisted Surgery*
Faculty of Medicine
lecture

*Medical Planning and Simulation Systems*
Faculty of Mathematics and Computer Science
lecture

*Surgical Navigation, Mechatronics and Robotics*
Faculty of Mathematics and Computer Science
lecture

*System Innovation in Medicine*
Faculty of Mathematics and Computer Science
lecture and seminar

---

**LEIPZIG UNIVERSITY OF APPLIED SCIENCES (HTWK)**

*Developing Medical Products*
Faculty of Electrical Engineering and Information Technology
lecture and seminar

*Project Management for Engineers*
Faculty of Electrical Engineering and Information Technology, Mechanical and Energy Engineering
lecture and seminar

*System Engineering*
Faculty of Electrical Engineering and Information Technology
lecture
MASTER DEGREES

Johannes Keller
„Entwicklung und Evaluation eines vernetzten Robotersystems für die Applikation von fokussiertem Ultraschall unter Verwendung des IEEE 11073 SDC Kommunikationsstandards“
Leipzig University

Tobias Pabst
„Konzeption und Implementierung eines Machine-Learning-Systems zur Erkennung ähnlicher Fingerabdrucksmerkmale von verwandten Personen“
Leipzig University of Applied Sciences (HTWK)

Lukas Schmieder
„A Practical Approach for a Decentralized Electronic Health Record“
Leipzig University

Gregor Thürk
„Entwurf und Konzeption eines Remote Access Alert Distribution and Assignment Systems unter Verwendung der IEEE 11073 SDC-Standardfamilie für den Einsatz in Intensivstationen“
Leipzig University of Applied Sciences (HTWK)

BACHELOR DEGREE

Roman Leipe
„Entwicklung eines Unterstützungssystems für die Langzeitbehandlung von Hypophysadenomen“
Leipzig University

Loris Rauch
„Webbasiertes HSI-Gewebeatlas. Implementierung eines Webbasierten Gewebeatlasses für hyperspektrale Daten“
University of Applied Sciences Zwickau (WHZ)
#ORGANIZATION

**EXECUTIVE DIRECTOR**

Melzer, Andreas  
Human Medicine & Dentistry

**VICE DIRECTOR**

Neumuth, Thomas  
Computer Science, Electrical Engineering

**STAFF**

<table>
<thead>
<tr>
<th>Name</th>
<th>First Name</th>
<th>Last Name</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adler</td>
<td>Nadine</td>
<td>Human Medicine</td>
<td></td>
</tr>
<tr>
<td>Alshirbaji</td>
<td>Tamer</td>
<td>Abdulbaki</td>
<td>Biomedical Engineering</td>
</tr>
<tr>
<td>Athner</td>
<td>Katrin</td>
<td>Business Management</td>
<td></td>
</tr>
<tr>
<td>Ballis</td>
<td>Nikoiaos</td>
<td>Chemistry, Human Medicine</td>
<td></td>
</tr>
<tr>
<td>Berger</td>
<td>Johann</td>
<td>Computer Science</td>
<td></td>
</tr>
<tr>
<td>Bieck</td>
<td>Richard</td>
<td>Computer Science</td>
<td></td>
</tr>
<tr>
<td>Bloße</td>
<td>Albrecht</td>
<td>Martin</td>
<td>Pedagogy</td>
</tr>
<tr>
<td>Buschbacher</td>
<td>Peter</td>
<td>Ralph</td>
<td>Informatics</td>
</tr>
<tr>
<td>Buyer</td>
<td>Julia</td>
<td>Human Medicine</td>
<td></td>
</tr>
<tr>
<td>Cabal Aragón</td>
<td>Jesús</td>
<td>Guilermo</td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>Chalopin</td>
<td>Claire</td>
<td></td>
<td>Mecial Imaging</td>
</tr>
<tr>
<td>Claussner</td>
<td>Jessica</td>
<td>Hospital Hygiene</td>
<td></td>
</tr>
<tr>
<td>Condori Alagón</td>
<td>Héctor</td>
<td></td>
<td>Bioinformatics and Physics</td>
</tr>
<tr>
<td>Cooney</td>
<td>Gary</td>
<td></td>
<td>Medicinal Chemistry</td>
</tr>
<tr>
<td>de Hoop</td>
<td>Tom</td>
<td>Human Medicine</td>
<td></td>
</tr>
<tr>
<td>Donig</td>
<td>Julian</td>
<td>Technical Radiology</td>
<td></td>
</tr>
<tr>
<td>Dussel</td>
<td>Nadine</td>
<td>Medical Engineering</td>
<td></td>
</tr>
<tr>
<td>Eger</td>
<td>Andreas</td>
<td>Mathematics and Physics</td>
<td></td>
</tr>
<tr>
<td>Fischer</td>
<td>Marcus</td>
<td>Humanities</td>
<td></td>
</tr>
<tr>
<td>Fitzner</td>
<td>Anne</td>
<td>Office Communication</td>
<td></td>
</tr>
<tr>
<td>Franke</td>
<td>Stefan</td>
<td>Computer Science</td>
<td></td>
</tr>
<tr>
<td>Fuchs</td>
<td>Reinhard</td>
<td>Electrical Engineering and Information Technology</td>
<td></td>
</tr>
<tr>
<td>Gaebel</td>
<td>Jan</td>
<td>Computer Science</td>
<td></td>
</tr>
<tr>
<td>Georgi</td>
<td>Christoph</td>
<td>Computer Science</td>
<td></td>
</tr>
<tr>
<td>Gholami Bajestani</td>
<td>Denis</td>
<td>Medical Engineering and Technical Mathematics</td>
<td></td>
</tr>
<tr>
<td>Giri</td>
<td>Priya</td>
<td>Mathematics</td>
<td></td>
</tr>
<tr>
<td>Girrbach</td>
<td>Felix</td>
<td>Human Medicine</td>
<td></td>
</tr>
<tr>
<td>Glaser</td>
<td>Bernhard</td>
<td>Computer Science</td>
<td></td>
</tr>
<tr>
<td>Handel</td>
<td>Till</td>
<td>Physics</td>
<td></td>
</tr>
<tr>
<td>Heinke</td>
<td>Robert</td>
<td>Mechanical Engineering</td>
<td></td>
</tr>
<tr>
<td>Henrichs</td>
<td>Ghazai</td>
<td>Computer Science</td>
<td></td>
</tr>
<tr>
<td>Hikal</td>
<td>Aisha</td>
<td>Human Medicine</td>
<td></td>
</tr>
<tr>
<td>Hoffmann</td>
<td>Phillip</td>
<td>Human Medicine and Computer Science</td>
<td></td>
</tr>
<tr>
<td>Hu</td>
<td>Shaonan</td>
<td>Pharmacology</td>
<td></td>
</tr>
<tr>
<td>Hühn</td>
<td>Marius</td>
<td>Human Medicine</td>
<td></td>
</tr>
<tr>
<td>Ihle</td>
<td>Maximilian</td>
<td>Pharmacy</td>
<td></td>
</tr>
<tr>
<td>Immel</td>
<td>Erwin</td>
<td>Medical Engineering</td>
<td></td>
</tr>
<tr>
<td>Ivanova</td>
<td>Galina</td>
<td>Computer Science</td>
<td></td>
</tr>
<tr>
<td>Jalal</td>
<td>Nour Aldeen</td>
<td>Biomedical Engineering</td>
<td></td>
</tr>
<tr>
<td>Keller</td>
<td>Johannes</td>
<td>Computer Science and Logic</td>
<td></td>
</tr>
<tr>
<td>Kießling</td>
<td>Lisa</td>
<td>Computer Science</td>
<td></td>
</tr>
<tr>
<td>Kindler</td>
<td>Johannes</td>
<td>Computer Science</td>
<td></td>
</tr>
<tr>
<td>Köhler</td>
<td>Hannes</td>
<td>Medical Engineering</td>
<td></td>
</tr>
<tr>
<td>Kongtso</td>
<td>Patrick</td>
<td>Computer Science</td>
<td></td>
</tr>
<tr>
<td>Kozlowski</td>
<td>Adam</td>
<td>Human Medicine</td>
<td></td>
</tr>
<tr>
<td>Krabbes</td>
<td>Frederik</td>
<td>Humanities</td>
<td></td>
</tr>
<tr>
<td>Kühner</td>
<td>Janne</td>
<td>Sophia</td>
<td>Human Medicine</td>
</tr>
</tbody>
</table>
Landeck, Tobias
Landgraf, Lisa
Leipe, Roman
Lindenmeyer, Adrian
Maktabi, Marianne
Matyash, Ivan
Mehlhorn, Stefanie
Melter, Andreas
Melzer, Leon
Menge, Alina
Meschke, Tim
Mrogowius, Julia
Mulk, Christina
Neumann, Juliane
Neumann, Anja
Neumann, Thomas
Oeser, Alexander
Pabst, Tobias
Pabst, Tobias
Patties, Ina
Petrova, Raya
Pfahl, Annekatrin
Prull, Alexander
Pysarczuk, Vincent
Rauch, Loris
Reich, Martin
Reske, Andreas
Richter, Jonas
Rockstroh, Max
Roy, Upasana
Sailer, Maria
Salz, Peter
Schenk, Martin
Schmierer, Lukas
Schneider, Dominic
Schneider, Daniel
Scholz, Kathrin
Schreiber, Erik
Schreiber, Max
Schröder, Anna
Seferling, Marvin
Tielesner, Mirjam
Thümmler, Moritz
Thürk, Gregor
Tkachenko, Maria
Tretbar, Steffen
Tschachtli, Christine
Tylcz, Jean-Baptiste
Unger, Michael
Urkova, Imen
Weber, Felix
Weitschat, Levin
Wermke, Ludwig
Wichmann, David
Wiegand, Ulrike
Wildfeuer, Valentina
Winkle, Sonja
Zarubin, Georgy
Zeumer, Christoph
Zhang, Xinrui
Zick, Laura
Ziemann, Martin

Human Medicine
Biology
Computer Science
Mechanical Engineering
Computer Science
Mechanical Engineering
Human Medicine
Human Medicine and Dentistry
Media Technology
Biochemistry
Business Informatica and Mathematics
Medical Engineering
Computer Science
Medical Engineering
Computer Science
Computer Science and Electrical Engineering
Media Management
Computer Science
Computer Science
Biochemistry
Business Informatica and Mathematics
Medical Engineering
Computer Science
Computer Science
Computer Science
Computer Science
Medical Engineering
Computer Science
Computer Science
Human Medicine
Health Informatics
Sensorics and Cognitive Psychology
Human Medicine
Human Medicine
Physics
Human Medicine and Technical Medicine
Medical Engineering
Human Medicine
Computer Science and Human Medicine
Physics
Human Medicine
Economics
Medical Engineering
Economics
Computer Science
Industrial Engineering and Human Medicine
Human Medicine
Human Medicine
Human Medicine
Computer Science
Mathematics and Computer Science
Humanities
Pharmacology
Human Medicine
Human Medicine
# ORGANIZATION

## ICCAS BOARD

**Prof. Dr. Andreas Melzer**
- Director | Innovation Center Computer Assisted Surgery

**Prof. Dr. Jürgen Meixensberger**
- Director | Department of Neurosurgery, Leipzig University Hospital

**Prof. Dr. Andreas Dietz**
- Director | Department of Otolaryngology, Leipzig University Hospital

**Prof. Dr. Michael A. Borger**
- Head of Department Cardiac Surgery, Leipzig University Hospital | Heart Center Leipzig

**Prof. Dr. Gerhard Hindricks**
- Medical Director and Senior Physician of the Department of Rhythmology | Heart Center Leipzig

**Univ.-Prof. Dr. Ines Gockel, MBA**
- Chair of the Department of Visceral, Thoracic and Vascular Surgery, Department of Operative Medicine (DOPM), University Hospital of Leipzig

**Prof. Dr. Heinz U. Lemke**
- Executive Director | International Foundation for Computer Assisted Radiology and Surgery (IFCARS)

**Prof. Dr. Ron Kikinis**
- Director | Fraunhofer Institute for Medical Image Computing MeVis
- Director | Surgical Planning Laboratory, Harvard Medical School, Boston, MA

**Robert Krieg PH.D.**
- Siemens Healthcare GmbH | VP in Siemens Healthineers’ business line Magnetic Resonance

**Prof. Dr. Nassir Navab**
- Head | Chair for Computer Aided Medical Procedures & Augmented Reality, Department of Informatics, Technical University Munich

**Prof. Dr. Dipl.-Ing. Thomas Schmitz-Rode**
- Director | Institute of Applied Medical Engineering, Helmholtz-Institute of RWTH Aachen University & Hospital

**Dr. Andrea Schenk**
- Member Management Board & Head of Liver Research | Fraunhofer Institute for Digital Medicine MEVIS, Bremen

## ADVISORY BOARD

**Prof. Dr. Bernhard Preim (spokesman)**
- Head | Visualization Group, Department of Simulation and Graphics, Faculty of Computer Science, Otto von Guericke University Magdeburg

**Prof. Dr. Volkmar Falk**
- Medical Director | Department of Cardiothoracic and Vascular Surgery, Deutsches Herzzentrum Berlin

**Dr.-Ing. Klaus Iiron**
- Department Chief | Research and Technology, Karl Storz SE & Co. KG

## CLINICAL COMMITTEE

**Dr. Harald Busse**
- Medical Physicist at the Department of Diagnostic and Interventional Radiology, Leipzig University Hospital

**Prof. Dr. Christian Etz**
- Senior Physician Aortic Surgery, Heart Center Leipzig; Director of the Saxonian Incubator for Clinical Translation (SIKT), Leipzig University

**Prof. Dr. Rainer Haak**
- Director of the Department of Dentistry and Parodontology, Leipzig University Hospital

**Dr. Dirk Halama**
- Head Senior Physician and Deputy Clinic Director at the Department for Head, Neck and Plastic Surgery, UKL
Prof. Dr. Dr. Thomas Hierl
• Senior consultant for oral and maxillofacial surgery and plastic surgery

Prof. Dr. Albrecht Hoffmeister
• Clinical Director Gastroenterology, Leipzig University Hospital

Dr. Philipp Kiefer
• Consultant Surgeon Catheter-assisted Valve Replacement/TAVI, Heart Center Leipzig

Prof. Dr. Martin Lacher
• Director of the Department for Paediatric Surgery, Leipzig University Hospital

PD Dr. Dirk Lindner
• Senior Physician at the Department of Neurosurgery, Leipzig University Hospital

Dr. Michael Moche
• Director at Department of Cardiac Surgery, Helios Park-Klinikum Leipzig

Dr. Thilo Noack
• Consultant Surgeon of the Clinic for Interventional radiology, Heart Center Leipzig

Dr. Markus Pirlich
• Senior Physician ENT medicine, Leipzig University Hospital

PD Dr. Andreas Reske
• Director of the Center of Anaesthesiology, Intensive Care Medicine, Emergency Medicine and Pain Therapy, Heinrich-Braun-Klinikum Zwickau

Prof. Dr.-Ing. Bernhard Sattler
• Head of the Medical Physics Section of the Department of Nuclear Medicine, Leipzig University Hospital

Prof. Dr. Sebastian Stehr
• Director of the Department for Anaesthesiology and Intensive Care, Leipzig University Hospital
# COOPERATIONS

NATIONAL COOPERATION PARTNERS

**Industry**
- ACL GmbH
- ADMEDES GmbH
- Bavaria Medizin Technologie GmbH
- Biotype Diagnostic GmbH
- C.R.S. iMotion GmbH
- Diaspective Vision GmbH
- Dornheim Medical Images GmbH
- Draeger AG & Co. KGaA
- Effigos AG
- EPflex Feinwerkechnik GmbH
- Fritz Stephan GmbH
- GADV – Gesellschaft für Automatisierung mit Datenverarbeitungsanlagen mbH
- Gesundheitsforen Leipzig GmbH
- GMC Systems mbh – Gesellschaft für medizinische Computersysteme mbH
- GTV – Gesellschaft für Technische Visualistik mbh
- healthcare Consulting GmbH
- HEBUmedical GmbH
- Ilara GmbH
- inomed Medizintechnik GmbH
- ITP GmbH – Society for intelligent textile products
- KARL STORZ SE & Co. KG
- KLS Martin Group – Gebrüder Martin GmbH & Co. KG
- LeFx GmbH
- LOCALITE GmbH
- METRAX GmbH, PRIMEDIC
- MR:comp
- NOTARZTDIENSTE.DE GmbH
- Nuromedia GmbH
- OFFIS – Institute for Information Technology e. V.
- Optris GmbH
- PHACON GmbH
- qcmed – Quality Consulting Medical GmbH
- Siemens Healthcare GmbH, Siemens Healthineers
- steute Technologies GmbH & Co. KG
- SurgiTAIX AG
- Synagon GmbH
- tecVenture GmbH
- UniTransferKlinik Lübeck GmbH
- VISUS Health IT GmbH
• voice INTER connect GmbH
• WEINMANN Emergency Medical Technology GmbH + Co. KG

Science
• AG Non-Invasive Cardiac Imaging
• Carl Gustav Carus University Hospital, Faculty of Medicine, OncoRay – National Center for Radiation Research in Oncology
• ERNW Research GmbH
• FIRST – The Fraunhofer Institute for Computer Architecture and Software Technology, Fraunhofer Institute for Applied Optics and Precision Engineering (IOF), Fraunhofer Institute for Biomedical Engineering (IBMT), Fraunhofer Institute for Cell Therapy and Immunology (IIZ), Fraunhofer Institute for Digital Medicine (MEVIS), Fraunhofer Institute for Integrated Circuits (IIS), Fraunhofer Institute for Manufacturing Engineering and Automation (IPA), Fraunhofer Institute for Open Communication Systems (FOKUS), Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute (HHI)
• Freie Universität Berlin, Institute of Computer Science, Workgroup Human-Centered Computing
• Georg-August-University of Göttingen, University Medical Center Göttingen (UMG), Institute for Diagnostic and Interventional Radiology
• Heidelberg University Hospital, Department of Otorhinolaryngology, Head and Neck Surgery, Department of Radiology
• Heinrich-Braun-Clinic (HBK) gemeinnützige GmbH
• Helmholtz Center Dresden Rossendorf (HZDR), Department of Neuroradiopharmaceuticals
• Jena University Hospital, Division Information Technology (IT), Department for ENT
• Johanniter-Unfall-Hilfe e.V.
• Leipzig Heart Center
• Leipzig University of Applied Sciences (HTWK), Faculty of Engineering (EIT), Institute for Electronics and Biomedical Information Technology (EBIT)
• Leipzig University, Center for Biotechnology and Biomedicine (BBZ), Faculty of Mathematics & Computer Science, Institute of Computer Science, Faculty of Medicine, Clinical Trial Centre (ZKS), Institute of Anatomy, Medical Informatics, Statistics and Epidemiology (IMISE), Saxon Incubator for Clinical Translation (SIKT)
• Max Planck Institute for Human Cognitive and Brain Sciences Leipzig, Department of Neurology
• OR.NET e.V.
• RWTH Aachen University, Helmholtz-Institute for Biomedical Engineering, Faculty of Electrical Engineering and Information Technology, Chair for Medical Information Technology (MedIT), Faculty of Mechanical Engineering, Chair of Medical Engineering
• Technical University of Munich (TUM), Department of Informatics, Chair of Robotics, Artificial Intelligence and Real-time Systems, Department of Mechanical Engineering, Chair of Micro Technology and Medical Device Technology (MIMED), Institute of Automation and
# COOPERATIONS

Information Systems (AIS), School of Medicine, Chair of Research Group Minimally invasive Interdisciplinary Therapeutrical Interventions (MITI), University Hospital rechts der Isar, Clinic and Polyclinic for Surgery, Department Visceral Interventions

- University Frankfurt, Center for Radiology
- University Hospital Leipzig, Clinic of Conservative Dentistry and Paradontology, Department of Anesthesiology and Intensive Care, Department of Diagnostic and Interventional Radiology, Department of Neurosurgery, Department of Nuclear Medicine, Department of Oral and Maxillofacial Surgery, Department of Orthopaedic, Traumat and Plastic Surgery, Department of Otolaryngology, Head and Neck Surgery, Department of Radiooncology, Department of Urology, Department of Visceral, Transplantation, Thoracic and Vascular Surgery, Medical Department IV – Cardiology, Medical Department V – Angiology
- University Hospital Regensburg, Department Internal Medicine II
- University Hospital Schleswig-Holstein, Department of Orthopedics and Traumatology, Office of Information Technology
- University Medical Center Göttingen (UMG), Clinic for Cardiology and Pneumology
- University Medical Center Knappschaftskrankenhaus Bochum, Clinic for Anesthesiology, Intensive Care and Pain Therapy
- University of Bremen, Department of Communications Engineering
- University of Lubeck, Institute for Electrical Engineering in Medicine (IME), Institute for Software Engineering and Programming Languages (ISP), Institute of Medical Informatics (IMI), Institute of Telematics (ITM)
- University of Rostock, Faculty of Computer Science and Electrical Engineering, Institute for Applied Microelectronic and Data Processing Technology (IMD)
- Zuse Institute for Information Technology Berlin (ZIB)

INTERNATIONAL COOPERATION PARTNERS

**Industry**
- GE HealthCare - Minn, USA
- Image Guided Therapy (IGT) - Pessac, France
- INSIGHTEC Ltd. - Tirat Carmel, Israel
- MeDrea Medical Science & Technology Ltd. - Chongqing, China
- MR Instruments Inc. - Minneapolis, USA

**Science/Politics**
- ASSR – Association of the Samaritans of the Slovakian Republic
- Children’s National Medical Center (CNMC)
- Chongqing University of Technology (CQUT)
- Danish Emergency Management Agency DEMA
• Delft University of Technology, Faculty of Mechanical, Maritime and Materials Engineering, Department of BioMechanical Engineering
• Estonian Ministry for Social Affairs, Estonian Health Board
• Federal Public Service (FPS) Health, Food Chain Safety and Environment
• French DG for Civil Protection and Crisis Management
• Harvard Medical School (HMS), Brigham and Women’s Hospital
• Higher Institute of Applied Technology of Kinshasa (ISTA)
• Inselspital, University Hospital Bern, University Clinic for Ear, Nose and Throat Diseases (ENT), Head and Neck Surgery
• Institute of Image-Guided Surgery (IHU)
• International Clinical Research Center of St. Anne’s University Hospital (FNUSA-ICRC)
• IRCAD France – Research Institute against Digestive Cancer
• Italian Civil Protection Department
• Medical University of Graz, Institute for Medical Informatics, Statistics and Documentation (IMI)
• Memorial Sloan Kettering Cancer Center (MSKCC)
• Menoufia University, Department of Computer Science and Engineering
• New York Presbyterian Brooklyn Methodist Hospital, Department of Radiology
• Romanian Ministry of Internal Affairs
• Sant’Anna – School of Advanced Studies, The BioRobotics Institute
• Swiss Federal Institute of Technology Zurich (ETH), Computer Vision Laboratory
• The Chaim Sheba Medical Center at Tel HaShomer
• University of Bern, ARTORG Center for Biomedical Engineering Research
• University of Dundee, Institute for Medical Science and Technology (IMSaT)
• University of Guanajuato, Department of Electrical Engineering
• University of Trento, Department of Information Engineering and Computer Science
• University of Turin, Department of Surgical Sciences
• University Trondheim, Department of Imaging and SINTEF Medical Technology
Diese Maßnahme wird mitfinanziert durch Steuermittel auf der Grundlage des vom Sächsischen Landtag beschlossenen Haushalts.