UNIVERSITÄT
LEIPZIG

Faculty of Medicine

ICCAS

#SMART_OR

#HYPER_SPECTRAL_IMAGING

#WORKFLOW #MR_GUIDED_INTERVENTIONS

#FOCUSED_ULTRASOUND

#MEDICAL_TECHNOLOGIES_MADE_SMART

#ROBOTICS #MODELBASED_MEDICINE

#PERSONALISED_MEDICINE

#LIFE_SUPPORT_SYSTEMS

ICCAS #ANNUAL_REPORT.2021

INNOVATION CENTER COMPUTER ASSISTED SURGERY

IMPRINT

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Faculty of Medicine
Innovation Center Computer Assisted Surgery (ICCAS)

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COVER
ICCAS' interconnected research.

PHOTOS
ICCAS I Innovation Center Computer Assisted Surgery
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Universitätsklinikum Leipzig (UKL)
Mitteldeutsches Krebszentrum: Hoenicke Informationsdesign

GRAPHIC ARTS
Simon Rosenow
Christoph Zeumer
Diana Pretzsch

Leipzig, March 2022

CONTENTS

#PREFACE

Dear Friends and Colleagues,

2021 has been another challenging year overshadowed by the COVID-19 pandemic and related restrictions continuously affecting and changing our day-to-day work and private life. Nevertheless, we were able to carry our crucial work forward. ICCAS' highly motivated staff achieved significant progress in a goal-oriented manner.

ICCAS has been involved in numerous online and real life events in the past year: offering networking opportunities, forging new cooperations, and bringing current research topics such as Artificial Intelligence (AI), 5G/6G, Virtual Reality (VR), Medical Robotics, Image-guided Diagnosis and Therapy to the attention of the professional community, stakeholder groups, and the wider public. One of the highlights in our event calendar has been the visit to our facilities by the Saxon Minister of State for Health, Social Affairs, and Social Cohesion Petra Köpping and Holger Mann, now Member of the German Bundestag. During the visit, our guests were introduced to our joint KAIT project with industrial partner Janssen Germany and the Department for Hematology, Cell Therapy and Hemostaseology at the University of Leipzig Medical Center (UKL). The project was kickstarted in the second half of 2020 and aims to develop an AI-based decision support tool for therapy selection for malignant and hematologic diseases.

In 2021, eight new projects were launched with public and industrial funding amounting to more than 2.3 million euros. The BMBF-funded joint project MR-Biopsy by our research group on Computer-assisted Image-guided Interventions in collaboration with industrial partner EPflex GmbH, the Leipzig Heart Center and the Departments of Nuclear Medicine, Cardiology and Radiology at the UKL, was successfully completed. The main results, which will be published shortly, include the design of MR compatible flexible biopsy forceps and a clinical workflow for MRI-guided endomyocardial biopsy. Both samples are soon to be tested in preclinical studies. We are also excited to announce that coming the second quarter of 2022, the research group will kickstart a new project dubbed 3MP FUS. ICCAS will be partnering with the Fraunhofer Institute for Biomedical Engineering (IBMT), the Max Planck Institute for Human Cognitive and Brain Sciences, the Localite GmbH and MRI-STaR GmbH. The partners will work jointly on neuromodulation therapies via Focused Ultrasound (FUS) in rare neuropsychiatric disorders.

Undoubtedly, a testament to the significance of our work in shaping the region's high-tech research landscape has been the shortlisting of the Center for Medicine Innovation (CMI) initiative

as a finalist to the open-topic BMBF competition for the establishment of a large-scale research center at the previous coal mining area in Central Germany (Mitteldeutsches Revier) with Thomas Neumuth as Co-Speaker. The CMI's goal is to advance personalized, affordable, and fair medicine that is equally accessible to all relying on a set of core technologies such as AI and Big Data, software-based drug modeling, cellular, genetic and vaccine technologies as well as smart medical systems and networking with a funding of 1.2 Billion € until 2038. The CMI will be a driving force behind a dynamically growing healthcare industry, and thus, propel the transformation of the Mitteldeutsche Revier into a high-tech region. The complete proposal for the ambitious concept will be submitted for the final round of the competition by the end of April 2022.

Additionally, ICCAS' team has been actively involved in and made valuable contributions to numerous leading symposia spanning three continents in 2021, including CARS, CURAC, COMPAMED&MEDICA, BMT, EAES, RSNA, the Hamlyn Symposium on Medical Robotics and the IEEE BHI-BSN. ICCAS also became a founding member of the first German interdisciplinary Center for Robot-Assisted and Navigated Surgery of the University of Leipzig Medical Center.

Finally, we are happy to announce that our institute has been recertified for another three years under the DIN EN ISO 13485 standard for medical device software, which allows us to continue providing our R&D services in accordance with the updated Medical Device Regulation (MDR).
We would like to thank everyone involved for the successful year 2021 and 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

2021

- ICCAS is founding member of the first center for robot-assisted and navigated surgery in Saxony
- Minister of State Petra Köpping and now Member of the Bundestag Holger Mann visit ICCAS
- Center for Medicine Innovation (CMI) selected to move to the next phase in the ideas competition „Wissen schafft Perspektiven für die Region“
- ICCAS involved within the framework for the establishment of the Comprehensive Cancer Center (CCC) for Central Germany
- Launch of projects EyeHearU, SCD Controlstation MED, MMMP FUS

2020

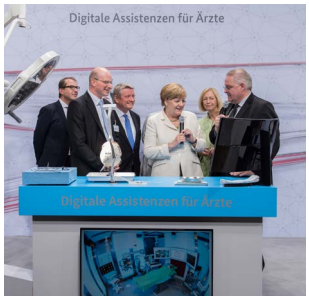
- 15th anniversary of ICCAS – Greetings and video message by Saxon Minister for Science Sebastian Gemkow
- Institute at the Faculty of Medicine at Leipzig University
- BMT in Leipzig – Opening by Federal Minister of Health Jens Spahn
- New Research Group Biomedical Data Analysis with project PostStroke (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 DORS inspired international participants
- ICCAS takes part at the Surgical Robot Challenge of the Hamlyn Symposium in London
- ICCAS hosts Steering Committee Meeting of the EUMFH 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

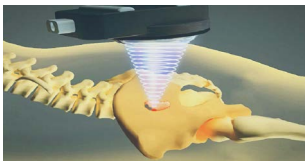
- ICCAS meets Federal Chancellor Angela Merkel at Digital Summit 2017
- 4th DORS consolidates its unique feature
- EUFUS 2017 & Preconference Workshop Experimental FUS and HIFU take place in Leipzig
- Successful non-invasive treatments with HIFU at Leipzig University Hospital
- PROJECT AREA Life Support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

2016

- Final presentation of the flagship project OR.Net
- ICCAS receives ISO 13485 certification
- Federal health minister visits ICCAS
- 3rd DORS
- Project start of Meta-ZIK SONO-RAY

2015

- Launching of cooperation with several scientific and clinical institutions
- 10th anniversary of ICCAS with 2nd 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



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

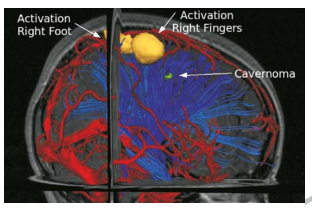
- TPU including ‚oncoflow' launched at Leipzig University Hospital
- PascAL (Patient Simulation Models for Surgical Training and Teaching) – research project by Leipzig University and HTWK Leipzig
- ICCAS plays a key role in the national BMBF research project 'OR.Net – Safe and Dynamic Networks in the 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

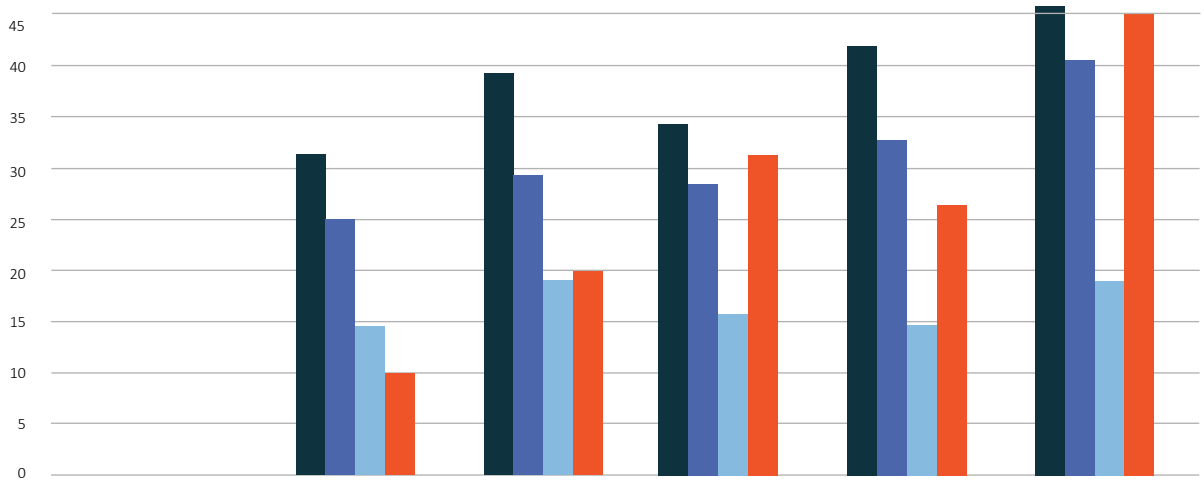
2011

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



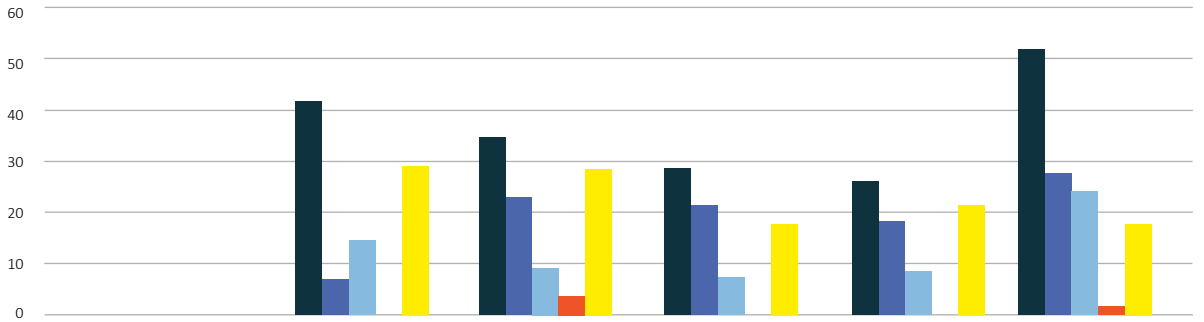
#FACTS AND FIGURES

HEADCOUNT



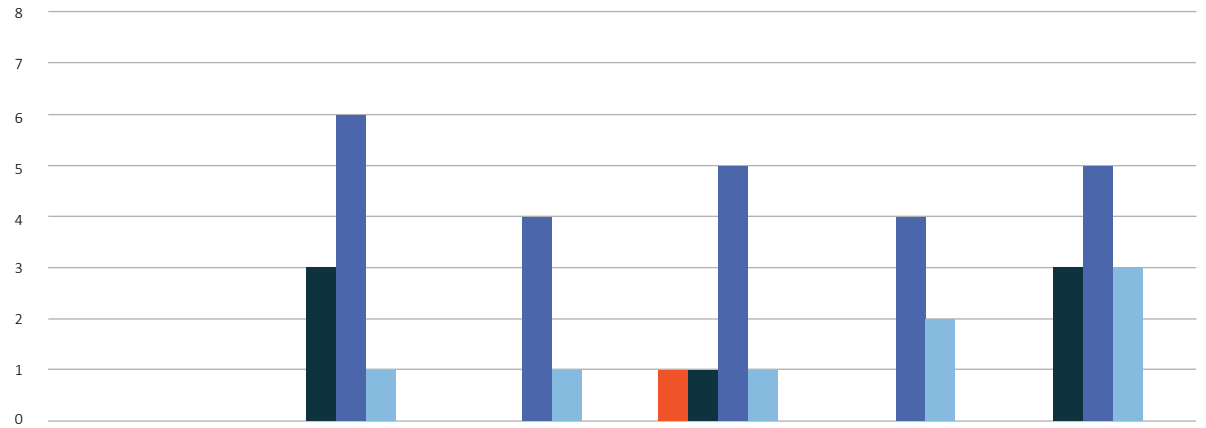
	2017	2018	2019	2020	2021
Research Associates	23	39	34	42	46
Research Associates (FTE)	25	29	28	33	41
Research Assistents	14	18	16	14	18
Guest Researchers	10	20	32	26	45

PUBLICATIONS



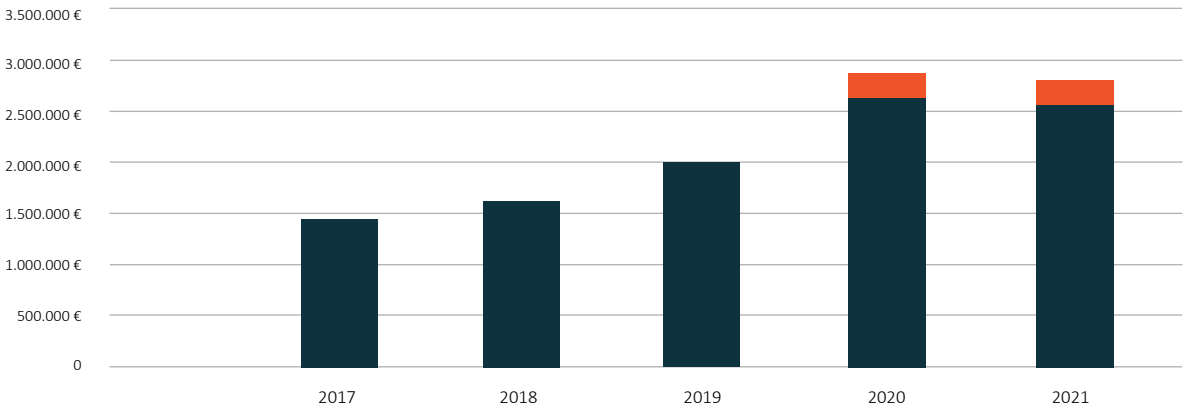
	2017	2018	2019	2020	2021
Total	42	35	28	26	51
First- and Senior Authorship	7	22	21	18	27
Co-Authorship	15	9	7	8	23
Book Chapters	0	4	0	0	1
Conference Proceedings	29	28	18	21	18

GRADUATIONS



	2017	2018	2019	2020	2021
Habilitation	0	0	1	0	0
Doctoral theses	3	0	1	0	3
Master theses	6	4	5	4	5
Bachelor theses	1	1	1	2	3

FUNDING



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 output.

#SELECTED ACTIVITIES

HIGHLIGHTS

MINISTER OF STATE PETRA KÖPPING AND NOW MEMBER OF THE BUNDESTAG HOLGER MANN VISIT ICCAS | JULY 8, 2021

The Saxon Minister of State for Social Affairs and Social Cohesion Petra Köpping and now member of the German Bundestag Holger Mann visited ICCAS to learn more about the status of the KAIT project. Uwe Platzbecker, Head of the Department for Hematology, Cell Therapy and Hemostaseology, Fabian Kreimendahl from Janssen Germany (our industrial partner), Thomas Neumuth as well as project coordinator from ICCAS Alexander Oeser and Anne Sophie Kubasch (UKL) presented the initiative. In addition to the KAIT project, our scientists presented the current research focus of ICCAS in the fields of artificial intelligence (AI), augmented reality (AR) and medical robotics in the in-house demo OR and robotics lab.

Photo: Swen Reichhold © ICCAS

ICCAS RECERTIFIED| DECEMBER 2021

ICCAS was recertified under DIN EN ISO 13485:2016 in December 2021 for another three years within the scope of „research and development of medical device software“. With the certificate renewal, we can reliably provide R&D services in accordance with MDR requirements to complement ongoing and new project cooperations with our partners.


TÜV PROFI CERT TÜV HESSEN

CERTIFICATE

for a management system as per

ISO 13485:2016
EN ISO 13485:2016+AC:2016

Evidence of conformity has been furnished.

iccas

Universität Leipzig
Innovation Center Computer Assisted Surgery
Semmelweisstraße 14
D-04103 Leipzig

scope:

Research and development of medical device software

Certificate registration No. 73 105 5200 | Certificate valid from 2021-12-28 to 2024-12-27
Audit report No. 4393 0225 | First certification 2016-06-23

IAF DAkkS

Certificate: ©TÜV Hessen

CENTER FOR MEDICINE INNOVATION IN THE FINAL RACE TO BECOME THE NEXT HIGH-TECH RESEARCH CENTER | JULY 23, 2021

The concept of the Center for Medicine Innovation (CMI) is the only finalist with a focus on medicine in the open topic ideas competition „Wissen schafft Perspektiven für die Region!“ organized by the Federal Ministry of Research and Education and the Free State of Saxony. The CMI is competing to become the high-tech research center in the previous

coal-mining area of Central Germany (Mitteldeutsches Revier) with an initial budget of up to 1.2 bn €. The CMI's competitive advantage lies in the expected transformative social and economic impact on all areas of society in the region and beyond through the interplay of medicine and life sciences, mathematics, physics, chemistry, engineering and information technology, which the center will be fostering.

Photo: punctum Fotografie, Photographer Stefan Hoyer © ICCAS

FOUNDING CEREMONY OF THE FIRST SAXON CENTER FOR ROBOT-ASSISTED AND NAVIGATED SURGERY | SEPTEMBER 29, 2021

The founding ceremony of the Center for Robot-Assisted and Navigated Surgery, to which ICCAS is a founding member, took place on September 29 at the University of Leipzig Medical Center (UKL).

Prof. Jens-Uwe Stolzenburg, Director of the UKL Clinic for Urology and leader of the new Center for Robot-Navigated Surgery, at a Da-Vinci surgical robot. Photo: © UKL

In order to meet the increasing demand for minimally invasive surgery, the new center consolidates the expertise from twelve disciplines in the implementation of robotic, navigation and IT-supported systems in the operating room. During the event, Andreas Melzer gave an introductory lecture and outlined the beginnings of the surgical robotic development, in which he was actively involved.

SELECTED EVENTS

ICCAS' STATUS SEMINAR | MARCH 11, 2021 | VIRTUAL

Marking the first successful 15 years in existence, ICCAS' Status Seminar 2021 was held virtually with around 90 participants. Andreas Melzer, Thomas Neumuth and Claire Chalopin presented the current results of our well-established research groups of Image-guided Focused Ultrasound, MR-guided Interventions, Model-Based Automation, Digital Patient Model, Life Support Systems, and Intraoperative Multimodal Imaging. In addition, ICCAS introduced a new research group headed by Galina Ivanova, which works in the field of biomedical data analysis.

Collage: ©ICCAS

#SELECTED ACTIVITIES

LIVE ROBOTICS DEMONSTRATION AT THE LONG NIGHT OF THE SCIENCES LEIPZIG 2021 | JULY 16, 2021

On July 16, ICCAS' robotics research group participated with a live robotics demonstration in the program of the largest annual joint event of Leipzig's scientific institutions: the Long Night of Sciences 2021. During the stream, Johann Berger, project coordinator on imaging robotics, gave an insight into the collaborative robotic system for the application in image-guided therapies and minimally invasive surgical procedures.

Photo: ©ICCAS

"MY HOLIDAY ADVENTURE" AT ICCAS | JULY 26, 2021

As part of this year's summer vacation program „My Holiday Adventure Leipzig" (MEFALE), children of employees of Leipzig University Medicine visited ICCAS.

Photo: Swen Reichhold © ICCAS

Under the guidance of our scientists, the children observed the automated insertion of a puncture needle into a patient phantom using a collaborative robot arm. In the demo operating room, the kids were able to try out for themselves a laparoscopic hyperspectral imaging system for measuring skin perfusion and tissue classification. As a highlight, the children had the opportunity to perform a keyhole surgery on a medical dummy and with the help of the endoscope and camera „surgically remove" the candy hidden in the abdominal cavity.

CLUB DER GESUNDHEITSWIRTSCHAFT VISITS ICCAS | AUGUST 19, 2021

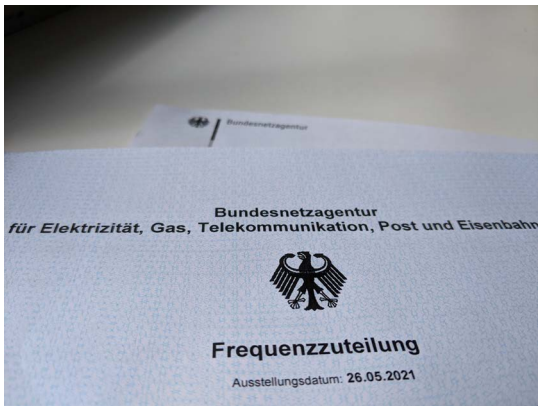
On August 19, about 40 decision makers from hospitals, hospital groups and companies involved in the healthcare sector visited ICCAS to learn more about our current research. ICCAS scientists held demonstrations at five stations for the visitors. There were insights into the further development of established project topics such as imaging robotics, medical technology networking and hyperspectral imaging for surgery. In addition, ICCAS presented its work focusing on augmented reality (AR) in combination with real-time 3D modeling to improve the planning and execution of surgical procedures.

©ICCAS

PROJECT-RELATED EVENTS

FIELD TEST PHASE FOR 5G-APPLICATION IN MEDICINE | MAY 26, 2021

As part of the MOMENTUM project funded by the German Federal Ministry of Education and Research, ICCAS has been assigned a 5G-frequency for the research on 5G-application in medicine. Thus, the ICCAS research project around 5G for emergency care and OR enters the field test phase, where heterogeneous technologies of networked medical equipment and IT systems must be integrated into a common 5G-based infrastructure.



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COMPREHENSIVE CANCER CENTER FOR CENTRAL GERMANY | AUGUST 31, 2021 | JENA

ICCAS is involved within the framework of the joint initiative between the University of Leipzig Medical Center and the University Hospital Jena towards the establishment of a Comprehensive Cancer Center (CCC) for Central Germany certified by the German Cancer Aid. On August 31, the partners on Digitally Assisted Precision Therapies held a workshop, at which Andreas Melzer contributed with his expertise on image-guided high intensity focused ultrasound in the noninvasive treatment of various benign and malignant lesions.

Photo: © Mitteldeutsches Krebszentrum: Hoenicke Informationsdesign

„SHAPING THE FUTURE OF HEMATOLOGY" WITH FOCUS ON ARTIFICIAL INTELLIGENCE | OCTOBER 8, 2021 | LEIPZIG

KAIT Project coordinator Alexander Oeser and ICCAS CTO Thomas Neumuth. Photo: Swen Reichhold © ICCAS

The hybrid event „Shaping the Future of Hematology" took place on October 8 at the Kunstkraftwerk Leipzig. The event focused on the role of Artificial Intelligence (AI) on the way to precision medicine for hematology. Special attention was given to the challenges in diagnosis and therapy as well as in dealing with Big Data. Contributions from ICCAS' research team around the KAIT project – a joint project with Janssen Germany and the Clinic and Polyclinic for Hematology, Cell Therapy

#SELECTED ACTIVITIES

and Hemostaseology (University of Leipzig Medical Center) – presented the prototype of an AI-based decision support tool for therapy selection in hematologic malignancies.

KICK-OFF MEETING TO A NEW RESEARCH PROJECT FUNDED BY THE GERMAN CANCER AID | OCTOBER 27 | LEIPZIG

ICCAS is project partner within the PRO-RED study funded by the German Cancer Aid under the leadership of the Clinic and Polyclinic for Hematology, Cell Therapy and Hemostaseology and the Clinic and Polyclinic for Medical Psychology and Medical Sociology at the University of Leipzig Medical Center (UKL). The research aims to fill a long-standing gap towards establishing international standards for transfusion strategies in low-risk patient with myelodysplastic syndrome (MDS).

Kick-off meeting with project partners. Photo: ©UKL

CO-AUTHORSHIP OF THE POSITION PAPER OF THE DGBMT IN VDE | DECEMBER 10, 2021

The Deutsche Gesellschaft der Biomedizinischen Technik im Verband der Elektrotechnik Elektronik und Informationstechnik e.V. (DGBMT in VDE) presented its current position paper on structural change in the biomedical sector through digitalization and artificial intelligence (AI). Andreas Melzer, as co-author, played a key role in shaping the content of the new publication. His long-standing expertise fed into the paper primarily in relation to the ever-growing application fields of medical robotics and image-guided techniques.

Link to publication

#HONORS AND AWARDS

ANDREAS MELZER INVITED ONCE AGAIN AS GUEST PROFESSOR IN SEOUL AND CONFIRMED AS COUNCIL MEMBER OF EAMBES| JANUARY & MARCH, 2021

The National Cancer Center Graduate School of Cancer Science and Policy (NCC-GSCP) in Seoul, South Korea, has reinstated Prof. Andreas Melzer as Visiting Professor for the period Spring 2021 to Fall 2023. Further, he was confirmed as Council Member of EAMBES 2023 and appointed to the election committee for new fellows of the Academy of Medical Sciences.

SHIFTS IN ICCAS ADVISORY BOARD | FEBRUARY, 2021

As a representative of our trusted industrial partner Siemens Healthineers, Dr. Robert Krieg will be succeeding Dr. Heinrich Kolem on ICCAS Scientific Advisory Board. Having received his PhD in physics, Dr. Krieg joined Siemens as early as 1991 and currently operates as the Vice President of the Magnetic Resonance Business Unit.

MARIANNE MAKTABI OBTAINS A DOCTORAL DEGREE | JUNE, 2021

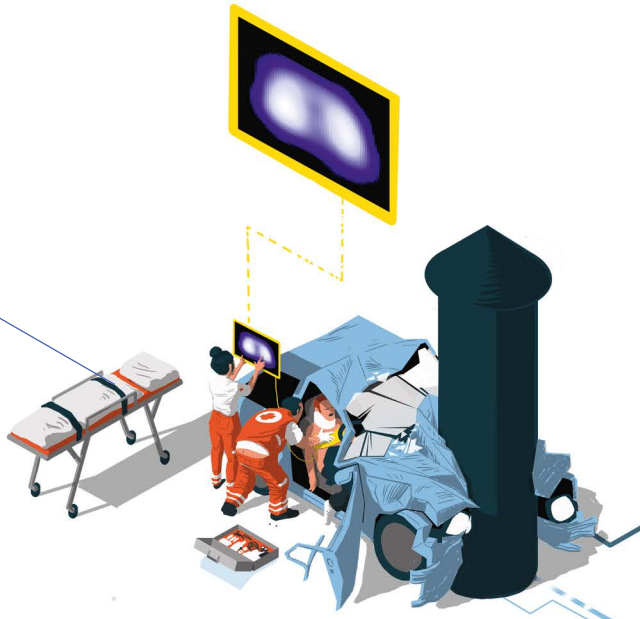
Marianne Maktabi obtains the academic degree of Dr. rer. med. at the Faculty of Medicine (Leipzig University). Her dissertation addresses the challenges around risk management in the digital operating room and investigates how frequency analysis of surgical workflows can be applied to improve patient safety and reduce resource conflicts during surgical procedures.

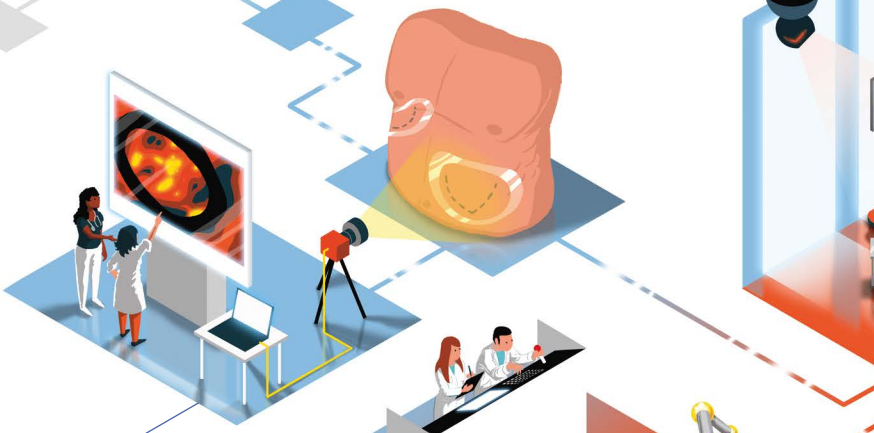
MAX ROCKSTROH OBTAINS DOCTORATE DEGREE | JANUARY, 2021

Max Rockstroh obtains the academic degree of Dr. rer. nat. at the Faculty of Medicine of Leipzig University. His dissertation addresses the challenges of process support in the operating room with a particular focus on activity monitoring and data storage as a basis for recognizing the surgical process.

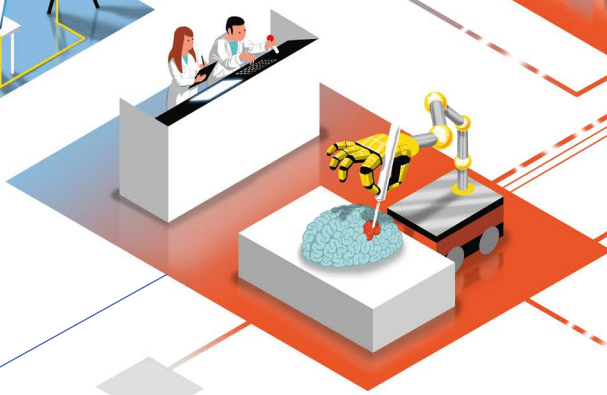
#INTERRELATED RESEARCH

#LIFE_SUPPORT_SYSTEMS



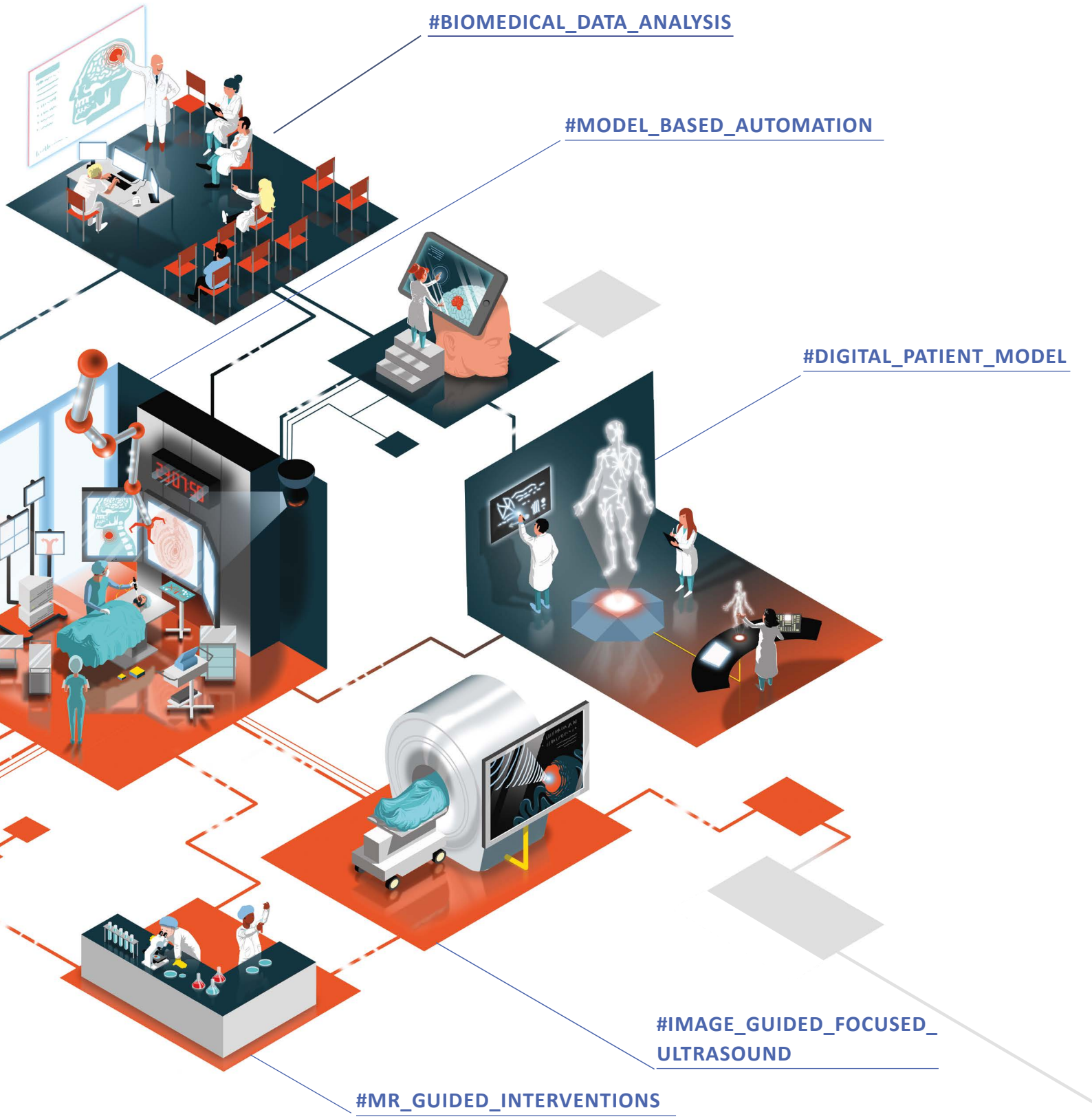


#INTRAOPERATIVE_MULTIMODAL_
IMAGING



#ROBOTICS

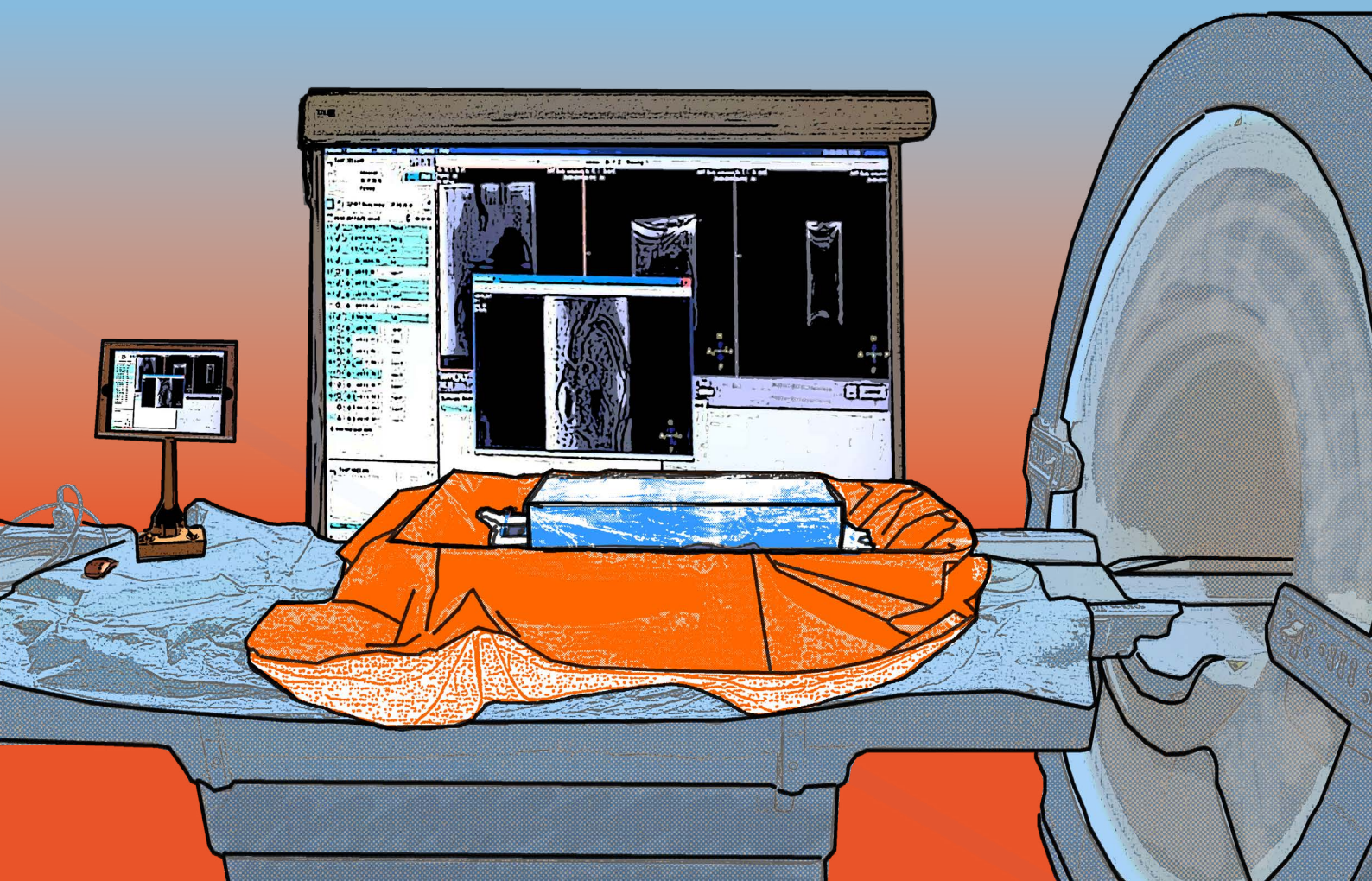
Interrelated research: #Computer_Assisted_Image_Guided Interventions
#Model_Based_Automation_and_Intelligent_OR
#Intraoperative_Multimodal_Imaging
#Biomedical_Data_Analysis



ICCAS

#COMPUTER_ASSISTED_IMAGE_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.



LEAD

Prof. Dr. Andreas Melzer

´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.´

SCIENTIFIC STAFF

Denis Bajestani, Johann Berger, Shanoan Hu, Lisa Landgraf, Christina Mulik, C. Martin Reich, Michael Unger, Xinrui Zhang

SELECTED PUBLICATIONS

- Zhang X, Landgraf L, Bailis N, Unger M, Jochimsen TH, Melzer A. Image-guided High-Intensity Focused Ultrasound, A Novel Application for Interventional Nuclear Medicine? J Nucl Med. 4. Juni 2021;62(9): 1181-1188. Impact factor: 10.057

- Reich CM, Sattler B, Jochimsen TH, Unger M, Melzer L, Landgraf L, Barthel H, Sabri O, Melzer A. Practical setting and potential applications of interventions guided by PET/MRI. Q J Nucl Med Mol Imaging. März 2021;65(1):43–50. Impact factor: 2.346

- Unger M, Berger J, Melzer A. Robot-Assisted Image-Guided Interventions. Front Robot AI. 2021;8:664622. Impact factor: 0.710

#COMPUTER_ASSISTED IMAGE_GUIDED INTERVENTIONS

SCIENTIFIC RESEARCH AREAS AND RELATED PROJECTS:

#IMAGE_GUIDED_FOCUSED_ULTRASOUND – IGFUS:

- CURE-OP | Combinational Ultrasound and Radiotherapy Enhanced Oncology Platform | Funding: BMBF
- Imaging Robotics | Concepts for Robotic-guided Focused Ultrasound Hyperthermia and Radiation Therapy in the Clinic | Funding: Freistaat Sachsen – SMWK
- Avatera Side-Docking | OpTImizing the PosiTIoning Principles of a Novel RoboTIc System |Funding: avateramedical GmbH
- MRgFUS | Non-invasive MagneTic-Resonance-Guided Focused Ultrasound (MRgFUS) for the Treatment of Uterine Fibroids – CollaboraTive Project with UKL
- LIFU | NeuromodulaTIon induced by Transcranial Focused Ultrasound (tFUS) Measured With EEG – collaboraTIve project with MPI and Fraunhofer IBMT

#MAGNETIC RESONANCE-GUIDED INTERVENTIONS – MRGI – LEAD: C. MARTIN REICH:

- MR-Thrombosis-Theranostic | MRI-guided Minimally Invasive Diagnostic and Therapy of Thrombosis | Funding: BMBF
- MR-Biopsy | MR Compatible Biopsy Forceps for Minimally Invasive Tissue Sampling | Funding: BMBF
- MR-Stents | MR-Guided Stent-Implantation |Funding: BMBF

Fig. 1: Prototypical system consisting of a Kuka LBR Med robotic arm with the treatment head attached.

Fig. 2: The setup of two KUKA lbr iiwa 7 R800 robot arms (KUKA AG, Augsburg) in the demonstrator OR at ICCAS Leipzig.

RESEARCH AREA: IMAGE GUIDED FOCUSED ULTRASOUND – IGFUS

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. To that end, a Kuka LBR Med robotic arm (Fig. 1) was combined with Theraclion's HIFU treatment head, while ICCAS is developing motion algorithms to ensure a stable acoustic coupling of the treatment head. A clinical study is being conducted in cooperation with the ENT department of the Leipzig University Medical Center to acquire data sets of CT and US scans to validate the algorithms developed in this project.

IMAGING ROBOTICS – CONCEPTS FOR ROBOTIC-GUIDED FOCUSED ULTRASOUND HYPERTHERMIA AND RADIATION THERAPY IN THE CLINIC

The robotics group at ICCAS aims for the integration of robotic systems into the clinical workflow of image-guided interventions. The main goal is a robotic system that provides various functions to serve in different use-cases and, thereby, improve acceptance in the clinic. 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 (Fig. 2). The effects of augmented reality-based approaches on user experience (i.e. path planning and visualization with a MICROSOFT HoloLens) are investigated in a Master Thesis. 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 in the same network. It was evaluated for ultrasound-guided biopsies and focused ultrasound ablations during the projects Sono-Ray and Cure-OP. The SDC communication of the system is optimized as part of a Bachelor Thesis.

AVATERA SIDE-DOCKING – OPTIMIZING THE POSITIONING PRINCIPLES OF A NOVEL ROBOTIC SYSTEM

Under commission by the avatera medical 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 of Leipzig Medical Center,

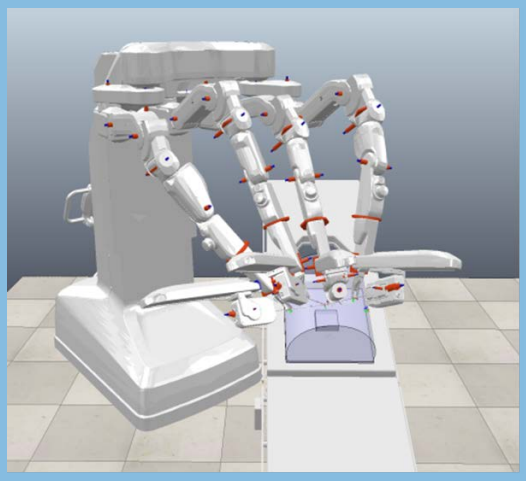


Fig. 3: The avatera robot model in the simulation environment CoppeliaSim (https://www.coppeliarobotics.com/).

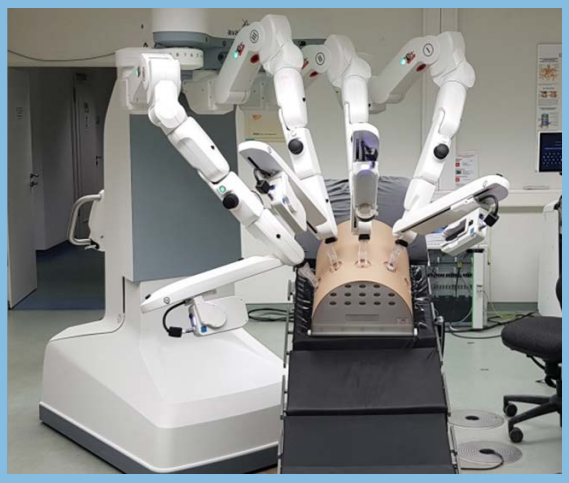


Fig. 4: The avatera robot positioned on a body phantom at ICCAS.

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 (Fig. 3), 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 (Fig. 4) 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 30 probands of varying expertise is currently underway.

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

Since 2017, a fibroid- treatment- center has been successfully established at the University of Leipzig Medical Center. The aim of the MRGFUS project 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, 46 of which received a MR-HIFU- Treatment (Fig. 5). 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 thoracoabdominal wall has taken place with satisfying symptom reduction.

NEUROMODULATION INDUCED BY TRANSCRANIAL FOCUSED ULTRASOUND (TFUS) MEASURED WITH EEG

Previous studies recommended 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.

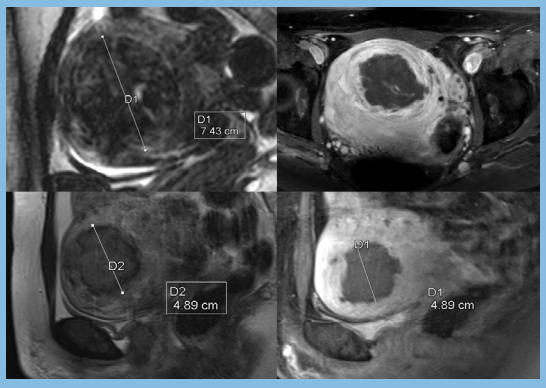


Fig. 5: Diagnostic T2-weighted- and contrast-enhanced- MR-images before, immediately and 6 months after MR-HIFU of a 39-year-old patient with a big intramural fibroid and hyper-/dysmenorrhea. Volume reduction and complete absence of symptoms 6 months after HIFU treatment was achieved, although the fibroid was not to 100% ablated (71% NPV).

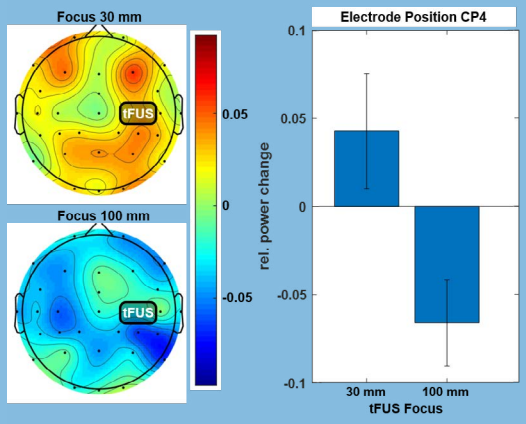


Fig. 6: Transcranial low intensity focused ultrasound modulate EEG activity depending on stimulation depth.

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 (Fig. 6).

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-THERANOSTICS – MRI-GUIDED MINIMALLY INVASIVE DIAGNOSTIC AND THERAPY OF THROMBOSIS

Blood clots disturb or block the physiological blood flow and can cause thromboembolism – in worst case life-threatening pulmonary embolism. In MR-THROMBOSIS-THERANOSTICS the beneficial features of MR imaging (excellent soft tissue contrast, flow sensitivity, adjustable contrast weighting & near real-time imaging) are used to improve thrombosis diagnosis and interventional treatment as an integrated theranostics approach.

To enable the procedural transfer to the MR imaging modality, conformity with regulations regarding MR safety and compatibility (ASTM and ISO norms) are attended and novel medical instruments and corresponding workflows are developed iteratively. The visualisation concept uses passive paramagnetic nanoparticles and resonant circuits to locally enhance the MR signal, allowing visualization of thromboembolisms that are trapped in implanted vena cava filters (VCF) or block peripheral arteries. A silicone-based patient model of a human arteriovenous vessel system was manufactured, allowing in-vitro testing of devices and workflows in cooperation with departments for Nuclear Medicine and Radiology at the University of Leipzig Medical Center. A pulsatile flow pump and in-vitro blood clots ensure lifelike testing conditions. Additionally, a technical interventional MRI setup was developed at the PET/MR at the Department of Nuclear Medicine, ensuring real-time control and communication between physician and technical staff (Fig. 7). By these means, first procedures have been successfully conducted with the patient model. An animal trial proposal has been submitted to validate instruments and workflow managed by the Fraunhofer Institute for Cell Therapy and Immunology (IZI), Leipzig.

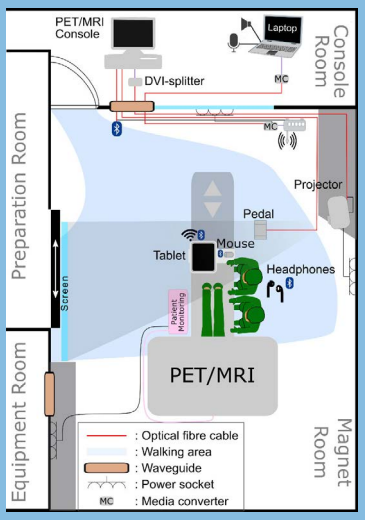


Fig. 7: Experimental interventional MRI interaction setup at Nuclear Medicine Clinic of the University of Leipzig Medical Center, which allows direct control of the scanner by the physician.

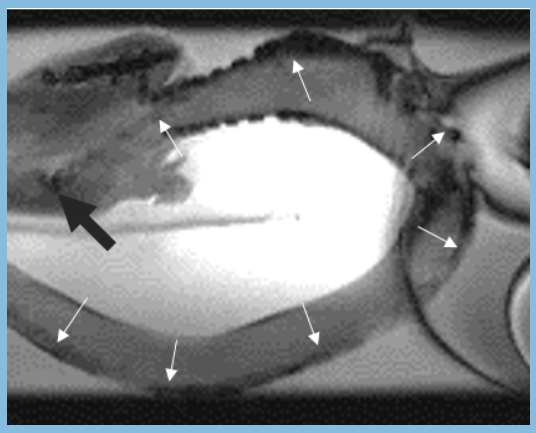


Fig. 8: Realtime-MRI during EMB in a patient model. Shaft (white arrows in aorta) and head (black arrow inside left ventricle) of the bioptome are visible due to passive MRI artefacts.

MR-BIOPSY – MR COMPATIBLE 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 significant exposure to ionizing radiation and nephrotoxic contrast agents. This poses risks, especially for young patients with recurring examinations. Goal of the joint project MR-BIOPSY was to overcome these disadvantages by transferring the EMB procedure into the magnetic resonance imaging (MRI) environment. Therefore, a worldwide first MR Conditional (according to ASTM F2503), flexible biopsy forceps, containing novel MRI markers, was developed. In an iterative process, an MRI-guided EMB was developed, ensuring MRI visibility and conformity of components with MR safety regulations standards. Feasibility of the procedure is supported by a corresponding clinical workflow developed in cooperation with the Department of Cardiology at the University of Leipzig Medical Center. An MR Safe hybrid life-size patient model- partly silicone model of a human arterial vessel system and a Thiel soft embalmed porcine heart (supported by the Dept of Anatomy)- was manufactured. Thus, general usability and visibility were proven in a realistic setting in both the cardiac catheterization laboratory and the MR environment, while an MRI-guided EMB was also performed successfully (Fig. 8).

MR-STENTS – MRI-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 often treated by stent implantation entailing repeated exposure to ionizing radiation. The aim of project MR-STENTS is to enable a MRI-guided stent implantation by developing the required MR compatible devices together with OEM medical device manufacturers. Novel MR-markers have been developed to visualize balloon catheter, delivery system and stent during MRI-guided stenting. These markers are based either on paramagnetic nanoparticles (passive) or on resonant circuits (semi-active) and work with corresponding MR sequences. A specially designed MR Safe stenosis-phantom was manufactured together with the former ICCAS spin-off Phacon (Leipzig) to investigate the visibility and applicability of the devices during the development process. It allows for a realistic simulation of stent implantation and serves as validation and training environment for the

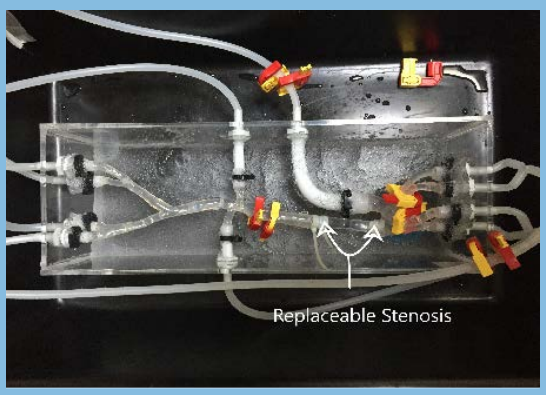


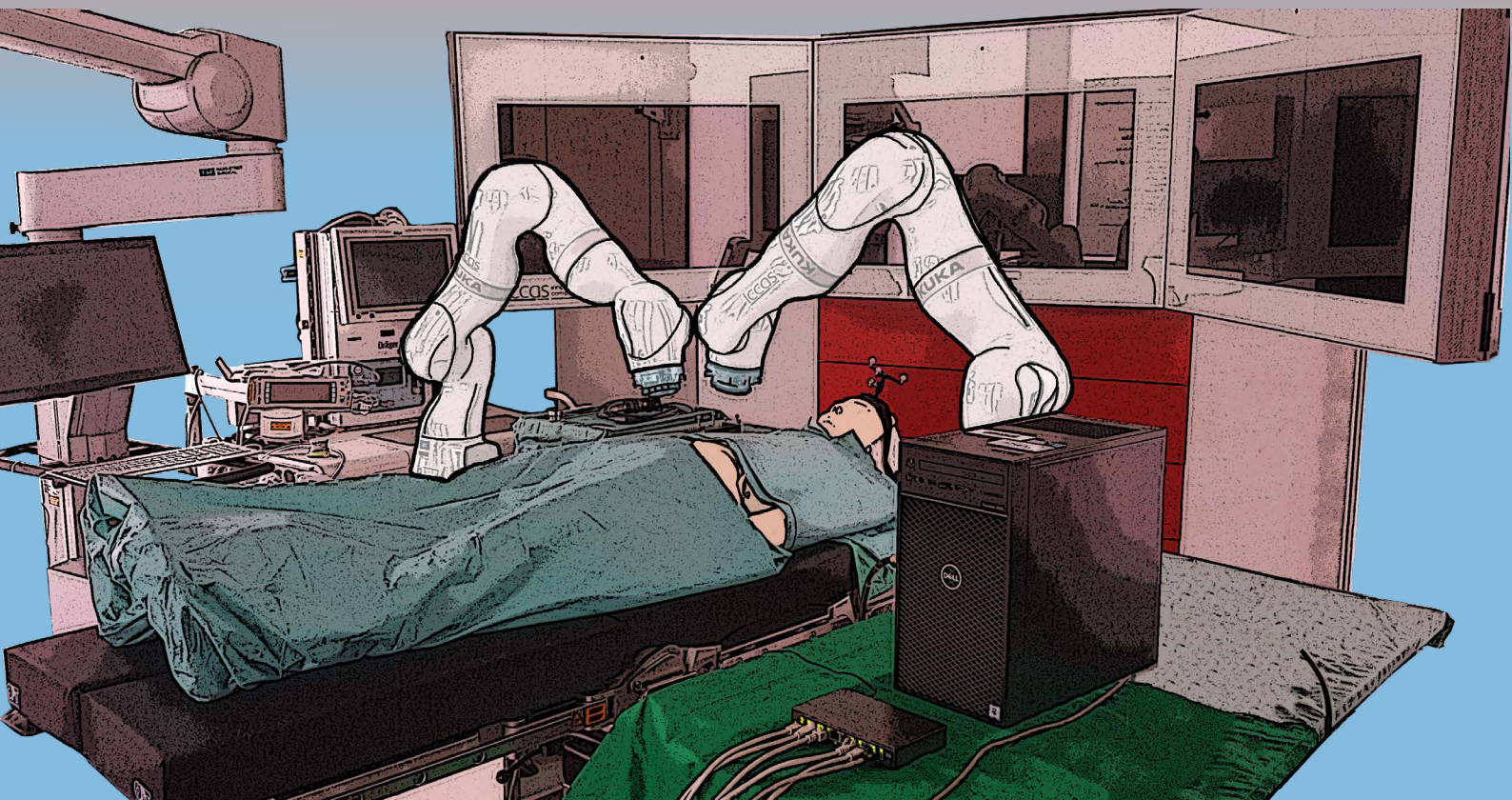
Fig. 9: MR Safe vascular phantom with flow simulation for testing samples in realtime-MRI.

instruments' handling as well as for the 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 other vascular diseases, esophagus, liver, and trachea-bronchial system (Fig. 9).

ICCAS

#MODEL_BASED_MEDICINE AND #INTELLIGENT_OR

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.



LEAD

Prof. Dr. Thomas Neumuth

´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

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SELECTED PUBLICATIONS

- Baur D, Bieck R, Berger J, Neumann J, Henkelmann J, Neumuth T, Heyde C, Voelker A. Analysis of the paraspinal muscle morphology of the lumbar spine using a convolutional neural network (CNN). Eur Spine J. 11. Dezember 2021; [online ahead of print] Impact factor: 3.314

- Huehn M, Gaebel J, Oeser A, Dietz A, Neumuth T, Wichmann G, Stoehr M. Bayesian Networks to Support Decision-Making for Immune-Checkpoint Blockade in Recurrent/Metastatic (R/M) Head and Neck Squamous Cell Carcinoma (HNSCC). Cancers (Basel). 23. November 2021;13(23):5890. Impact factor: 6.639

- Maktabi M, Neumuth T. Situation-Dependent Medical Device Risk Estimation: Design and Evaluation of an Equipment Management Center For Vendor-Independent Integrated Operating Rooms. J Patient Saf. 1. Oktober 2021;17(7):e622–30. Impact factor: 2.844

#MODEL_BASED_MEDICINE AND #INTELLIGENT_OR

SCIENTIFIC RESEARCH AREAS AND RELATED PROJECTS:

#MODEL_BASED_AUTOMATION:

- MOMENTUM | Mobile Medical Technology for Integrated Emergency Care and Trauma Medicine | Funding: BMBF
- COMPASS | Comprehensive Surgical Landscape Guidance System for Immersive Assistance in Minimally-invasive and Microscopic Interventions | Funding: BMBF
- EYEHEARU | Multimodal Acquisition, Simulation and Audiovisual Enhancement for the Individual Training of Basic Functional Laparoscopic Skills | Funding: DFG
- SDC-CSM – SDC – ControlStation Med | Integration of the New SDC Communication Protocol Family into the Daily Workflow of Technical Staff Members in Clinical Environments – collaborative project with GADV mbH | Funding: BMWi
- SCADS.AI | Center for Scalable Data Analytics and Artificial Intelligence – collaborative project | Funding: BMBF

#DIGITAL_PATIENT_MODEL:

- MPM | Models for Personlized Medicine | Funding: BMBF
- AIQNET | 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 | Patient-based Individual Modeling of Paraspinal Collateral Network Perfusion after Segmental Artery Occlusion | Funding: European Union – H2020 – GA-no. 733203
- GenoMed4All | Genomics and Personalised Medicine for all through Artificial Intelligence in Haematological Diseases | Funding: EU
- SaxoCell | Automation Platform for Cell Product Manufacturing | Funding: BMBF
- NFDI4DS | NFDI for Data Science and Artificial Intelligence | Funding: DFG
- GAIA-X | Integration Interface Digital Patient Model | Funding: Acatech Plattform Lernende Systeme

#LIFE_SUPPORT_SYSTEMS:

- VITALS | Visualization of Thorax-related Analysis of Life-Signals | Funding: BMWi – ZIM-program
- 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
- EOS | Emergency Medical Team Operating System

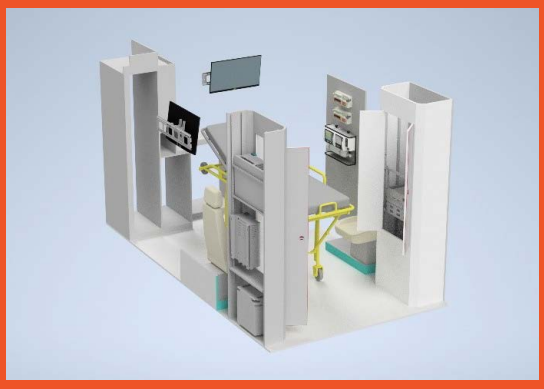

Fig. 10a: Internal structure of the networked ambulance as CAD model.

Fig. 10b: AR application for visualization of multidimensional data.

RESEARCH AREA: MODEL BASED AUTOMATION AND INTEGRATION – MAI

MOMENTUM – MOBILE MEDICAL TECHNOLOGY FOR INTEGRATED EMERGENCY CARE AND TRAUMA MEDICINE

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, the use of 5G-mobile communications technology is being evaluated based on networking within the ambulance using a 5G small cell and between the ambulance and the hospital or telemedical facility using a public mobile communications network. A hardware and software architecture have been developed for the two networking scenarios. Together with the partners, special emphasis was placed on IT security. The networking addresses two goals from the end user‘s point of view. 1) Existing systems for pre-registration of patients in the clinic or telemedical applications can be expanded to include additional data sources, and control is made possible right down to the medical device in the ambulance. 2) 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 for a new type of supply chain between ambulance and trauma room and enables new kinds of medical applications at the scene of accident and an improved preparation in the trauma center.

Currently, the ICCAS is working with our industry partners to develop the various central architecture components. These include, for example, various gateways and authentication components. Furthermore, the technical requirements for the networked ambulance were specified and the modification has been started. In preparation for the evaluation, several end-user applications for the ambulance and the trauma room were specified and implemented. In these, the various data can be brought together and thus generate added value for the end users. Here, both classic technologies such as tablets and smartphones as well as applications from the XR area are implemented. After a continuous development-accompanying evaluation with our clinical partners from trauma surgery and anesthesiology, planning has begun for the final evaluation with all stakeholders. This is scheduled for the second half of 2022. (Fig. 10a, 10b)

Fig. 11: The COMPASS principle for vision- and language-based navigation assistance in minimally-invasive surgery.

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. 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. A neural machine translation model was then trained to predict future navigation steps of the endoscope. We successfully showed that a verbalized description of the endoscope movement could be reproduced. In a second step, the translation model was extended to generate surgical reports from intra-operative comments, previous surgical reports and endoscopic video data. In a final step, the model will also contain a submodule to perform classification tasks during the procedure. In this way, classification, prediction and documentation tasks will be summarized in a unified neuronal architecture to establish a comprehensible navigation aid through navigation awareness. Additionally, computed image properties will also reinforce sentence descriptions (Fig. 11).

EYEHEARU – MULTIMODAL ACQUISITION, SIMULATION AND AUDIOVISUAL ENHANCEMENT FOR THE INDIVIDUAL TRAINING OF BASIC FUNCTIONAL LAPAROSCOPIC SKILLS

The EyeHearU research project develops a novel training approach based on the multisensory recording of the training process. The individual training progress is thus recorded, simulated, and supported accordingly by audiovisual feedback. For this purpose, a knowledge base of basic bimanual laparoscopic skills is created, described in a machine-understandable way, and compared with the instantaneous recording of the individual training. For the assessment of the training success, existing subjective questionnaires for the description of the general laparoscopic expertise will be supplemented by new objective and machine understandable metrics.

SDC-CSM – SDC – CONTROLSTATION MED

'SDC – Control Station Med' is a joint research and development project by GADV mbH and ICCAS, which started on 1 September 2021. The project, which is expected to be success-

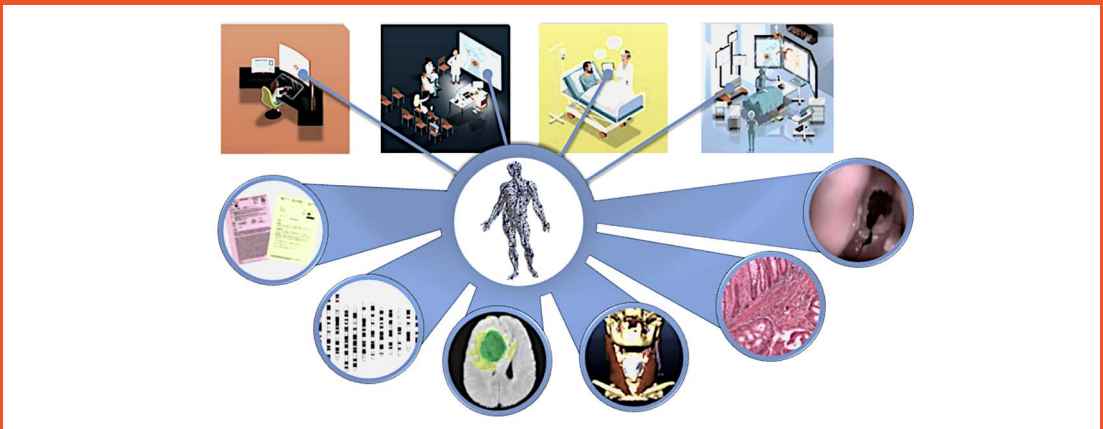

Fig. 12: The project Models for Personalized Medicine develops knowledge graphs, machine learning methods and assistance applications for cancer treatment.

fully completed by August 2023, focusses on the integration of the new SDC communication protocol family into the daily workflow of technical staff members in clinical environments. The aim is to connect all SDC-able medical devices used in the different departments, e.g. intensive care units, laboratories, or operation rooms, to a control station located in the medical-technical department. This control station is expected to provide different services such as automatic error handling, documentation, visualization of the system status, or management ratios to facilitate work processes. After having completed the requirements analysis within the expected timeframe, the project is now moving forward to the next steps, i.e. system design and architecture.

SCADS.AI – CENTER FOR SCALABLE DATA ANALYTICS AND ARTIFICIAL INTELLIGENCE

As one of the recently opened German centers for Artificial Intelligence (AI), ScaDS.AI aims to close the gap between efficient use of large amounts of data in both industry and research and advanced AI methods. For this purpose, the research topics at ScaDS.AI range from foundational AI methodology up to the application of AI in key areas like engineering, environmental systems, industry, and biomedical research, cooperating with many local companies and scientific institutions. Furthermore, increasing the public trust in AI is taken into consideration by integrating ethical and societal perspectives and making research available through the service center and Living Lab. To push forward AI in the life sciences, ScaDS.AI cooperates with ICCAS by sharing research expertise and computing resources, focusing primarily on model-based, personalized cancer treatments.

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, as well as 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

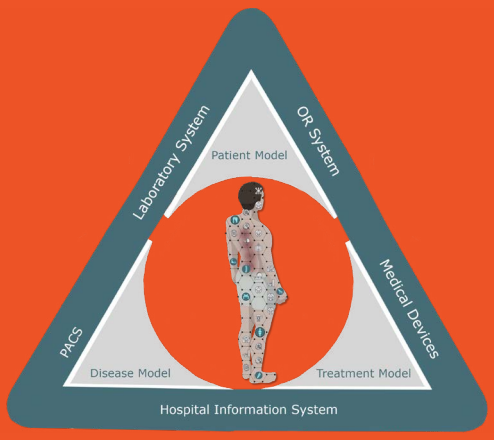

Fig. 13: Digital Patient Model for Clinical Studies.

knowledge modeling and data semantics. Clinical knowledge, such as guidelines, scoring systems and studies, were 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 a software, called Digital Medical Twin. Based on the formalized clinical knowledge and the interlinked patient data, its modules handle multimodal analyses, data-based predictions, or risk assessments to provide reasoned evidence to complex clinical decision making. The developed models and the data interface serve as a basis for applications for personalized tumor therapy in the context of the project. They provide a common understanding of work processes, patient data and decision-making processes as a flexible starting point 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 treatment 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 by implementing studies as well as the integration of novel applications in cooperation with regional SME partners and the clinical users. (Fig. 12)

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, 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 AIQNET project. Within the framework of the platform, a database will be

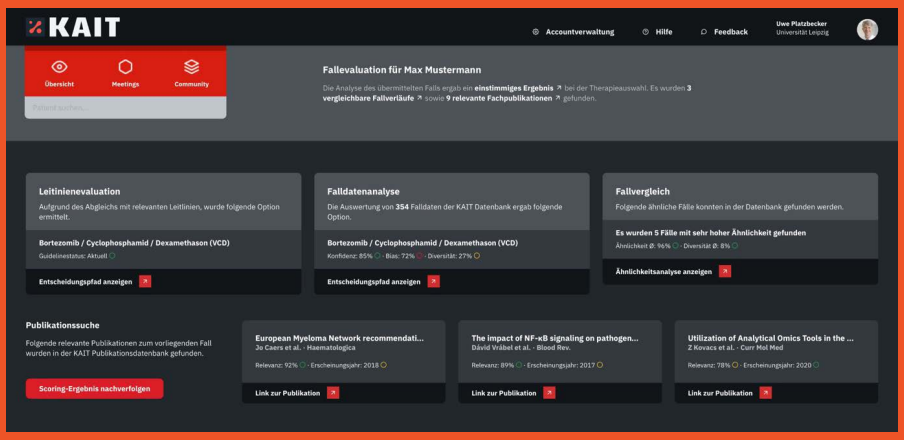

Fig. 14: Overview of an AI-assisted medical case evaluation using KAIT's internal processing capabilities.

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 Division of Spine Surgery at the University of Leipzig Medical Center, ICCAS develops a "Digital Patient Model" (Fig. 13). The model integrates different perspectives on the diagnosis and the disease, information on therapies, and the specific characteristics of the patient. With this information base, relevant data is available for clinical trials, which benefits further clinical research on healthcare outcomes. Moreover, prototypic AI-based assistance systems for clinical decision support (e.g. AI-based identification of muscle and fat tissue of the lumbar spine), information visualization (e.g. data fusion in the operating room), and predictive trend analysis, are developed and evaluated. Thereby, the AI-supported clinical quality and performance assessment could be improved based on previous knowledge about the patient and the treatment.

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 is 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 (Fig. 14).

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

While hemodialysis 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

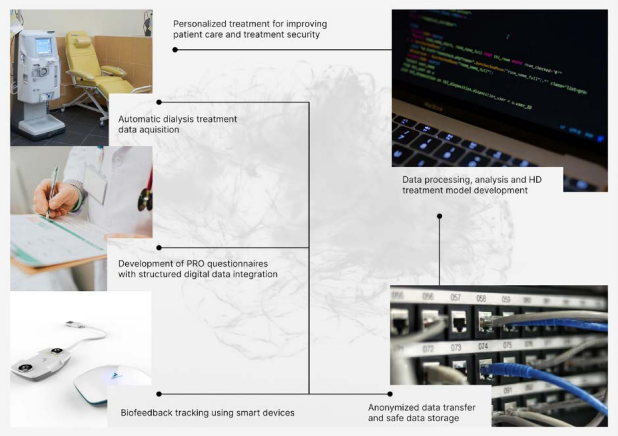

Fig. 15: Overview of the modeling approach and development stages.

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 (Fig. 15).

PAPA-ARTIS – PATIENT-BASED INDIVIDUAL MODELING OF PARASPINAL COLLATERAL NETWORK PERFUSION AFTER SEGMENTAL ARTERY OCCLUSION

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 spinal nerve tissue. The approach to preemptively seal segmental arteries through coiling is investigated in the multi-centric clinical EU project PAPA-ARTiS. ICCAS is supporting the scientific validation of the procedure with computational models to correlate the coiling pattern of segmental arteries with the clinical outcome. Through Machine Learning-based processing of tabularized patient data, a classification model was generated that assists the selection and pattern of coiling the segmentals. The classification model uses patient parameters like demographics as well as data on the process of coiling and the recuperation. Through the calculation of SHAP values from the classification models, physicians also receive insight on the statistical value of patient parameters for the overall success of the procedure (Fig. 16).

GENOMED4ALL – GENOMICS AND PERSONALISED MEDICINE FOR ALL THROUGH ARTIFICIAL INTELLIGENCE IN HAEMATOLOGICAL DISEASES

The GenoMed4All project is an EU-wide initiative for the establishment of a network-infrastructure that connects medical institutions. The goal is to facilitate the exchange of clinical data in a federated learning framework. By integrating valuable clinical data up

Fig. 16: Overview of the modeling approach and development stages.

to multi-OMICS levels, the project aims to significantly improve quantitative analysis using machine learning (ML) and artificial intelligence (AI) methods. GenoMed4All focuses on a range of hematological diseases, which are becoming increasingly complex due to the particularly advanced utilization of precision diagnostics and personalized therapies. In partnership with the Clinic and Polyclinic for Hematology, Cell Therapy and Hemostaseology at the University of Leipzig Medical Center, ICCAS is contributing to the implementation of the federated data integration mechanisms as well as advanced data standardization based on HL7 FHIR.

SAXOCELL – AUTOMATION PLATFORM FOR CELL PRODUCT MANUFACTURING

As part of the SaxoCell precision therapy cluster, ICCAS is supporting the development of an automation platform for cell product manufacturing (ATMP) in the subproject „SaxoCell Systems“. In the future, this will enable the robust scaling of the production of cell therapeutics for clinical applications. The focus will be on concepts and applications for automated ATMP manufacturing as well as the linkage with novel quality control mechanisms, e.g. through intelligent quality management or process control via artificial intelligence (AI) methods. All aspects will be developed according to the principles of Good Manufacturing Practice (GMP) and will be accompanied by detailed training courses for personnel in the field of ATMP and automation.

NFDI FOR DATA SCIENCE AND ARTIFICIAL INTELLIGENCE (NFDI4DS)

The project ‘Nationale Forschungsdateninfrastruktur für Datenwissenschaften und künstliche Intelligenz’ (NFDI4DS) intends to represent the Data Science and Artificial Intelligence community in academia. Its research efforts will adapt existing solutions while collaborating with the other NFDI consortia to establish common interfaces. In the initial phase, NFDI4DS will focus on four application areas: language technology, biomedical sciences, information sciences and social sciences. Within the consortium, ICCAS is leading the subproject on biomedical sciences. The subproject is integrating biomedical data into the overall infrastructure that heavily relies on the FAIR data principles. The main challenges include anonymization of case-related data as well as interoperability of data sources, datasets, and software components, based on standardized interfaces.

GAIA-X – INTEGRATION INTERFACE DIGITAL PATIENT MODEL

Efficient health care requires data originating from various sources of the clinical en-

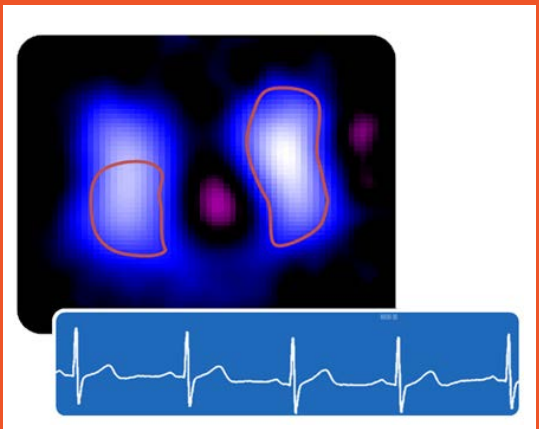

Fig. 17: UP: Reconstructed EIT image with perfused lung areas framed in red; DOWN: ECG curve used for trigger-algorithm

vironment that are intuitively usable and semantically linked. In reality, however, clinical data is often loosely structured and stored in continuous text or raw data. The research and development of a digital patient model (DPM) to tackle said problems is part of the MPM project (Models for Personalized Medicine) at ICCAS. MPM focuses on semantic data integration and multimodal data analysis. The GAIA-X digital patient model project serves as complementary research for MPM to extend possible applications of the DPM. The aim is the development of concepts to integrate the technology of a DPM into the GAIA-X ecosystem and, thereby, share pseudonymised population-based data, trained models and analysis modules between institutions and countries inside the EU.

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. In cooperation with Fritz Stephan GmbH, ITP GmbH and the Leipzig University of Applied Sciences, ICCAS develops a system, which enables simultaneous Electrical Impedance Tomography (EIT) and Electrocardiography (ECG). After an initial requirement analysis phase, the partners designed and realized a prototype, which performs both measurement methods at the same time by use of one electrode textile. Captured data can be displayed and analyzed in real-time, with the benefit of combining EIT and ECG values immediately after measuring. At the moment, doctors and engineers work on the implementation and validation of data fusion and ECG-triggered EIT perfusion analysis, which will allow the real-time detection and evaluation of existing oxygenation problems (Fig. 17).

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. The aim of the collaboration between GAMPT mbH Merseburg and ICCAS is to develop a ultrasound wearable that can be used to monitor blood flow in the common carotid artery. Throughout the ongoing development, Dr. Lenk from University of Leipzig Medical Center provided hands-on

advice and complements the process with his medical experience. Subsequently, GAMPT mbH produced a first prototype sensor that was delivered to ICCAS and used for Doppler measurements in the common carotid artery. For an experimental setup, an ultrasound phantom on basis of MRI data was produced to accurately capture the carotid geometry. Currently, a flow system is being developed that will be coupled with the phantom to simulate CPR. This experimental setup will then be used to further evaluate the US-Prototype and implement algorithms for blood-flow estimation.

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

The AutoCuff project is a R&D project between the Asskea GmbH and ICCAS, which aims for the development of an automatic, interoperable, mobile system for subglottic suction and cuff pressure control. The combination of both pressure devices in one system enables medical personnel to increase patient care quality and decrease the risk of patient compromise and pneumonias, especially during times where each intubated patient cannot be tended to individually. Based on research and clinical user interviews, the partners developed a technical solution, which allows for both functions, without one pressure regulation influencing the other one. An optional module, responsible for communication with other interoperable devices or systems, can be implemented into the device, allowing for the dispatch of alarms, warnings, therapy-relevant information and the parametrization of device-settings by authorized personnel. Use cases for interoperable communication include the incremental cuff inflation, in case of leakage and the resulting loss of Positive End-Expiratory Pressure, detected by pressure-regulated respirators.

EOS – EMERGENCY MEDICAL TEAM OPERATING SYSTEM

The “EMT Operating System” (EOS) is a field hospital information system, which is tailored to the requirements of Emergency Medical Teams (EMTs) on disaster relief missions. Its idea was created and designed during the EUMFH-Project. The system supports the entire patient treatment process from triage to discharge and is highly configurable to adapt to the needs of the EMT. Despite EOS being primarily designed as an electronic patient record, it also includes essential functions for EMT mission and field hospital management. Besides patient management and treatment documentation, EOS enables quick department configuration, visualization of important hospital key performance indicators (patient admissions, triage category count, department workload, etc.), and reporting functionalities (e.g. to local government or WHO).

#BIOMEDICAL_DATA_ANALYSIS

LEAD
Prof. Dr. Galina Ivanova

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

PROJECT
- PostStroke | Mobile, Digital System to Strengthen Relapse Prevention, Health Competence and Self-reliance | Funding: Freistaat Sachsen – eHealthSax

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

Every year, around 270,000 people in Germany suffer an acute stroke. For most of those affected, this results in physical limitations and psychological symptoms, such that the stroke often turns into a chronic disease. In order to support patients in the often difficult time after a stroke, the Biomedical Data Analysis group at ICCAS, together with the Clinic and Polyclinic for Neurology at the University of Leipzig Medical Center, is developing an innovative, digital concept to improve stroke follow-up care. The so-called PostStroke Manager includes a patient app connected to mobile devices, as well as portals embedded in an IT infrastructure for access by primary care physicians and stroke controllers. The system is already being tested and optimized in a pilot study with patients. An intersectoral feasibility study from the acute hospital to the home environment is already underway.

Patient Kit

#INTRAOPERATIVE_ MULTIMODAL_IMAGING

LEAD
PD Dr. Claire Chalopin

SCIENTIFIC STAFF
Hannes Köhler, Marianne Maktabi, Annekatrin Pfahl, Michael Unger

PROJECTS
- LYSIS | Development of a Laparoscopic Hyperspectral Imgaging System| Funding: BMBF – KMU innovativ
- SORLIC | Development of an Assistance System for the Intra-Operative Planning of Flap Surgeries | Funding: BMWi
- MSI Endoscopy|Endoscopic Real-time Pulse Oximetry Imaging System for Medical Applications | Funding: Karl Storz SE & Co. KG
- HSI Laparo/Endoscopy|Automated Tissue Recognition and Visualisation with Laparoscopic Hyperspectral Imaging | Funding: Karl Storz SE & Co. KG
- MultiGuard | Development of a Multispectral Patient Monitoring System | Funding: BMWi

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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 surgery. The goal of this project, performed in collaboration with the company Diaspective Vision GmbH,

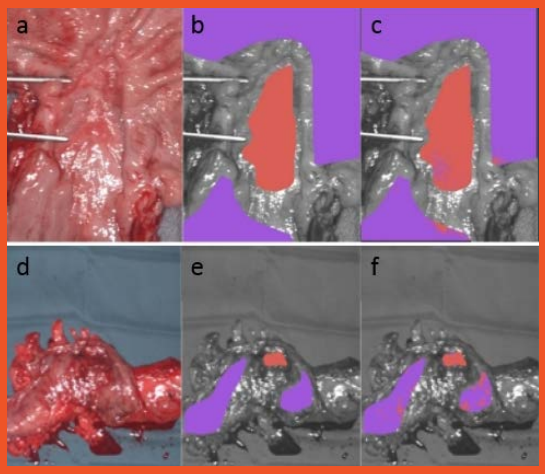

Fig. 18: Results of a 3D CNN model for the automatic identification of tumors of the esophagus (a to c) and colon (d to f). (a) and (d): the RGB images of the fresh resected tissues. (b) and (e): the ground truth tissue annotations (healthy tissue in purple and tumor in red). (c) and (f): the tissue classes predicted by the 3D CNN.

Fig. 19: Augmented reality image of the forearm overlaid with the equivalent thermal image using the Microsoft Hololens V2.

is the technical development and clinical evaluation of an endoscopic HSI system and computer-assisted approaches to automatically identify tissues and organs during minimal-invasive operations.

Approaches using 3D Convolution Neural Networks (3D CNN) were developed and successfully evaluated to automatically identify esophagus and colorectal tumors in fresh-resected tissue based on HSI data acquired with an HSI system for open surgeries (Fig. 18). The endoscopic HSI system developed by Diaspective Vision was certified for clinical use. A prototype is currently being evaluated at the hospital on patients during operations. The comparison with the open HSI system showed small differences between the parameter values (near-infrared perfusion, oxygenation saturation, hemoglobin and water content) and the absorbance spectra. However, these differences are expected to be mainly due to the different technologies of the light sources. One algorithm for automatic tissue classification was successfully integrated with the software of the company. The project was completed successfully in September 2021.

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

The aim of the 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 is being developed to support the surgeon during the planning of the procedure. The locations of the blood vessels as well as a proposal for the optimal positioning of the transplant will be visualized using augmented reality (Fig. 19).

MSI ENDOSCOPY – ENDOSCOPIC REAL-TIME PULSE OXIMETRY IMAGING SYSTEM FOR MEDICAL APPLICATIONS

Multispectral Imaging (MSI) provides information beyond the visual range and might support surgeons to assess the tissue perfusion state in real-time. For applications during minimally invasive surgery, an endoscopic system is devised in this project.

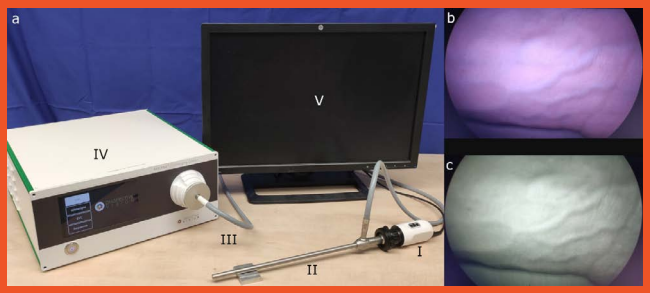

Fig. 20a-c: a) First prototype of the endoscopic MSI system developed by Diaspective Vision GmbH: I) hand-held camera, II) standard laparoscope (10 mm, 0°, KARL STORZ SE & Co. KG), III) light cable, IV) imaging center including light source and computing unit, V) monitor. b) Visualization of the wrist in white light mode. c) Visualization of the wrist in EVC mode.

Fig. 21: Laparoscopic HSI-System and colour video of esophagogastric resectate with tissue oxygenation colour map overlay.

A prototype was developed by Diaspective Vision GmbH (Fig. 20a) and was evaluated technically by KARL STORZ SE & Co. KG and ICCAS. It contains switchable, narrow-band LEDs emitting in the spectral range from 405 to 960 nm and so far, provides a white light video and an Enhanced Vessel Contrast (EVC) mode (Fig. 20b-c). After feasibility studies developing spatially resolved pulse oximetry parameters from red-green-blue (RGB) data, further tasks of ICCAS are the adaption of algorithms to MSI data and the conduction of (pre-) clinical trials.

HSI LAPARO/ENDOSCOPY – AUTOMATED TISSUE RECOGNITION AND VISUALISATION WITH LAPAROSCOPIC HYPERSPECTRAL IMAGING

Laparoscopic hyperspectral imaging (HSI) for intraoperative perfusion assessment 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 was de-veloped in the LYSiS project.

In a clinical evaluation study, HSI data of gastrointestinal resectates were acquired with the new laparoscopic HSI-system and quantitatively compared with measurements from an approved HSI-system for open surgery. Currently, in-vivo measurements for further evaluations are conducted with our clinical partners. The developed methods for the registration of the HSI data with the colour video are currently evaluated and continuously improved. The resulting information are visualised using augmented reality methods (Fig. 21).

MULTIGUARD – DEVELOPMENT OF A MULTISPECTRAL PATIENT MONITORING SYSTEM

Tissue perfusion and moisture are physiological parameters that reflect the healthy state of patients. Currently, the standard methods, such as pulse oximetry and transcutaneous electrodes, have limitations especially with respect to the application to premature babies. The devices are in contact with the body and measure the local perfusion. The goal of the MultiGuard project, conducted in collaboration with Diaspective Vision GmbH, is the development of a contactless and non-invasive multispectral system. The system includes a multispectral measurement unit and image processing tools to compute and visualize continuously perfusion and pulsatile parameters, fat and water content. The developed system will be evaluated at the intensive care unit and neonatology department.

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Kubasch A-S, Oeser A, Grieb N, Meschke T, Weigert A, Gloaguen S, Sockel K, Schmierer L, Nenoff K, Metzeler K, Neumuth T, Platzbecker U. Development of a semantic and causal model for treatment decision making in myelodysplastic syndromes. In: Jahrestagung der Deutschen Gesellschaft für Hämatologie und Medizinische Onkologie (DGHO); 2021.

Maktabi M, Wichmann Y, Köhler H, Chalopin C, Jansen-Winkeln B, Ahle H, Lorenz D, Gockel I, Thieme R. Entwicklung eines semi-automatischen Entscheidungsprozesses mittels hyperspektraler Bildgebung zur Identifizierung von Karzinomzellen in Resektaten von Patienten mit ösophagealem Adenokarzinom. In: Viszeralmedizin 2021, 75. Gemeinsame Jahrestagung Deutsche Gesellschaft für Gastroenterologie, Verdauungs- und Stoffwechselkrankheiten (DGVS), Sektion Endoskopie der DGVS, Deutsche Gesellschaft für Allgemein und Viszeralchirurgie (DGAV); 2021.

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Matyash I, Kutzner R, Neumuth T, Rockstroh M. Accuracy measurement of HoloLens2 IMUs in medical environments. In: 55th Annual Conference of the German Society for Biomedical Engineering (BMT); 2021.

Michalski D, Prost A, Handel T, Schreiber M, Tylcz J-B, Urban D, Geisler S, Schramm S, Lippmann S, Gullnick J, Claßen J, Ivanova G. PostStroke-Manager: Modellprojekt für ein patientenzentriertes Unterstützungssystem unter Nutzung mobiler digitaler Technologien und einer Lotsenbegleitung in der Schlaganfallnachsorge. In: 94. Jahrestagung der Deutschen Gesellschaft für Neurologie (DGN); 2021.

Osterhoff G, Kießling L, Vogel C, Fakler J, Neumuth T, Neumann J. TraumaFlow - Entwicklung einer Workflow-Assistenz für die Behandlung von Traumapatienten im Schockraum. In: Deutscher Kongress für Orthopädie und Unfallchirurgie; 2021.

Pabst T, Stegemann D, Georgi C, Kasparick M, Suleder J, Neumuth T, u. a. TeleSDC: Concept for ISO/IEEE 11073 SDC in telemedicine across unreliable networks. In: 55th Annual Conference of the German Society for Biomedical Engineering (BMT); 2021.

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Stöhr M, Hühn M, Gaebel J, Dietz A, Oeser A, Wichmann G. Model for decision support of molecular pathological parameters in head and neck cancer. In: 92.&91. Jahresversammlung der Deutsche Gesellschaft für als-Nasen-Ohren-Heilkunde (DGHNO-KHC); 2021.

Tylcz J-B, Prost A, Geisler D, Urban D, Schreiber M, Handel T, u. a. Toward an efficient mobile system for stroke case managers: requirements. In: IEEE EMBS International Conference on Biomedical and Health Informatics (BHI); 2021.

Wiegand S, Hinz A, Wichmann G, Dietz A, Neumuth T, Mehnert-Theuerkauf A, u. a. Longitudinale Analyse von Dysphagie, Stimmproblemen und Schmerzen nach Therapie von Kopf-Hals-Tumoren. In: 92.&91. Jahresversammlung der Deutsche Gesellschaft für als-Nasen-Ohren-Heilkunde (DGHNO-KHC); 2021.

Zebralla V, Wichmann G, Georgi C, Neumuth T, Dietz A, Wiegand S. Einfluss der SARS-CoV-2-Pandemie auf Angst und Depressivität bei Kopf-Hals-Tumorpatienten. In: 30. Jahrestagung der Vereinigung Mitteldeutscher Hals-Nasen-Ohrenärzte (MDHNO); 2021.

#EVENTS

IN-HOUSE EVENTS

ICCAS STATUS SEMINAR AND ADVISORY BOARD MEETING 2021

March 11, 2022 | Virtual, ICCAS

Project presentations from ICCAS' established areas of research – Computer-Assisted Image-Guided Interventions, Model-based Medicine, and Intraoperative Multimodal Imaging – as well as Introduction to the new research field at ICCAS dedicated to Biomedical Data Analysis.

ICCAS BOARD MEETING

June 6, 2021 | Virtual, ICCAS

MINISTER OF STATE PETRA KÖPPING AND MEMBER OF THE STATE PARLIAMENT HOLGER MANN VISIT ICCAS

July 8, 2021 | ICCAS

- Stefan Franke | OR Demonstration
- Johann Berger | Demonstration in Medical Robotics and Focused Ultrasound

17TH SUMMER MEFALE (MEIN FERIENABENTEUER LEIPZIG) 2021

26 July, 2021| ICCAS

- Annekatrin Pfahl | Demonstration in Hyperspectral Imaging
- Johann Berger | Demonstration in Medical Robotics

THE "CLUB DER GESUNDHEITSWIRTSCHAFT" VISITS ICCAS

August 19, 2021 | ICCAS

- Ivan Matyash |Demonstration in Augmented Reality (AR) Technology in the Planning and Execution of Surgical Procedures
- Tobias Pabst | Demonstration of Workflow Management Software for ENT Minimally Invasive Procedures in the Demo OR
- Annekatrin Pfahl | Demonstration in Hyperspectral Imaging
- Michael Unger | Demonstration in Medical Robotics

ICCAS PRESENTATION FOR THE CENTRAL EVENT MANAGEMENT AT THE UNIVERSITY OF LEIPZIG MEDICAL CENTER

August 30, 2021|ICCAS

- Stefan Franke | OR Demonstration
- Sabrina Jans | Greeting, Reception, Cooperation Opportunities
- Ivan Matyash | Demonstration in Augmented Reality (AR) Technology

OR DEMONSTRATION AND PRESENTATION OF THE KAIT PROJECT TO THE NEW PROFESSOR FOR MEDICAL DATA SCIENCE AT LEIPZIG UNIVERSITY TORALF KIRSTEN

October 1, 2021 | ICCAS

- Thomas Neumuth, Stefan Franke, Jan Gaebel, Alexander Oeser

BOARD OF DIRECTORS TO THE UNIVERSITY OF LEIPZIG MEDICAL CENTER

November 8, 2021 | ICCAS

- Johann Berger | Demonstration in Medical Robotics
- Claire Chalopin, Marie-Sophie Braun and Hannes Köhler |Demonstration in Hyperspectral Imaging
- Stefan Franke | OR Demonstration
- Alexander Oeser| Presentation of the KAIT Project and Models for Personalized Medicine

VISIT BY THE DEUTSCHE GESELLSCHAFT FÜR ALLGEMEIN- UND VISZERALCHIRURGIE

November 15, 2021 | ICCAS

- Johann Berger | Demonstration in Medical Robotics
- Claire Chalopin and Hannes Köhler |Demonstration in Hyperspectral Imaging
- Stefan Franke | OR Demonstration

CONFERENCES, SYMPOSIA, WORKSHOPS

DGBMT BOARD MEETING

January 25, 2021 | Virtual

- Andreas Melzer in his capacity as Board Member

EUROPEAN CONGRESS OF RADIOLOGY (ECR) 2021

- **March 3-7, 2021 | Vienna**
- Andreas Melzer | Lecture: Intraoperative/interventional MRI: Methods and Applications

50TH CONGRESS OF THE GERMAN SOCIETY FOR ENDOSCOPY AND IMAGING TECHNIQUES E.V. (DGE-BV)

April 8-10, 2021| Virtual

- Andreas Melzer in his capacity as Board Member

BIG-DATA.AI SUMMIT 2021

April 21-22, 2021 | Virtual

- Thomas Neumuth | Artificial Intelligence (AI) for the treatment of leukemia

#EVENTS

69TH ANNUAL CONFERENCE OF THE ASSOCIATION OF SOUTH GERMAN ORTHOPEDIC SURGEONS AND TRAUMA SURGEONS

April 28 – May 1, 2021 | Virtual

- Max Rockstroh | Presentation of the MOMENTUM Project

92ND ANNUAL MEETING OF THE GERMAN SOCIETY FOR OTORHINOLARYNGOLOGY, HEAD AND NECK SURGERY

May 12 – 16, 2021 | Virtual

- Andreas Melzer | Keynote chair of the Joint Meeting with the DGBMT on Technical innovations for the „ENT-OP of the future“

INNOVATION FORUM HYPERSPECTRAL TECHNOLOGIES – HYPERINNO

May 20, 2021 | Virtual

- Claire Chalopin | Lecture: Hyperspectral Imaging Techniques within Medical Imaging

5G DIALOGUE EVENT OF THE CITY OF LEIPZIG

June 11, 2021 | Leipzig

- Thomas Neumuth | Discussion

HAMLYN SYMPOSIUM ON MEDICAL ROBOTICS

June 16 | virtual

- Andreas Melzer | Workshop: Towards Robotic Autonomy in Surgery, Invited Lecture Imaging Robotics
- Johann Berger | Paper submission: A Standardized Service-oriented Dual-arm System for image-guided interventions

CARS 2021 COMPUTER ASSISTED RADIOLOGY AND SURGERY

June 21 – 25, 2021 | Virtual

- Thomas Neumuth | Keynote chair: Image-guided Interventions
- Claire Chalopin| Lecture: Segmentation Study of Brain Tumor Contours in 3D Intraoperative Ultrasound Imaging, Improvement of a Navigation System for Brain Tumor Surgical Procedures Based on Intraoperative Ultrasound Imaging

„WEBCAST: KREBSMEDIZIN AKTUELL“ (UKL) IMAGE- & COMPUTER-ASSISTED PRECISION SURGERY

June 23 – 26, 2021| Virtual

- Thomas Neumuth| Lecture: Technology Innovations for Surgery: Current Preclinical Research Topics

MEDICAL DEVICE MR SAFETY SPECIALIST | MRSS – USA

June 24 – 26, 2021 | Virtual

- Andreas Melzer | Workshop: Hands-on Course on MR Safety with an RF-induced Heating Experiment

10TH SAXON HEMATOLOGICUM 2021

July 9, 2021 | Greifswald

- Thomas Neumuth | Lecture: Artificial Intelligence in Medicine – fact or fiction?
- Alexander Oeser | Presentation of the KAIT Project

LONG NIGHT OF THE SCIENCES LEIPZIG

July 16, 2021 | Virtual, Leipzig

- Johann Berger | Demonstration: Live Robotics Demonstration

IEEE-EMBS INTERNATIONAL CONFERENCE ON BIOMEDICAL AND HEALTH INFORMATICS (BHI'21)

July 27 – 30, 2021 | Virtual

- Andreas Melzer | Member lecture: Regulatory issues related to Software as Medical Device involving Artificial Intelligence
- Jean-Baptiste Tylcz | Presentation: Toward an efficient mobile system for stroke case managers: requirements

17TH IEEE-EMBS INTERNATIONAL CONFERENCE ON WEARABLE AND IMPLANTABLE BODY SENSOR NETWORKS (BSN'21)

July 27 – 30, 2021 | Virtual

- Galina Ivanova | Organizer of the Special Session on "Mobile Digital Solutions in Patient Care – Challenges and Opportunities"

ELECTIVE MODULE ON „ROBOTIC SURGERY IN GYNECOLOGY AND VISCERAL SURGERY" AT THE UNIVERSITY OF LEIPZIG MEDICAL CENTER (UKL)

July 28, 2021 | Leipzig

- Andreas Melzer | Lecture: Imaging Robotics

12TH ANNUAL SYMPOSIUM PHYSICS OF CANCER

August 30 – September 1, 2021 | Virtual, Leipzig

- Andreas Melzer | Invited lecture: Magnetic Resonance Guided Focused Ultrasound – Mechanical and Thermal Effects

CHIRURGISCHE FORSCHUNGSTAGE LEIPZIG

September 2 – 3, 2021 | Virtual, Leipzig

- Andreas Melzer| Lecture: Computer-assisted Surgery; co-moderator of the session on Computer-based Support Systems and Virtual OR Planning
- Ines Gockel, Claire Chalopin | Workshop: Intraoperative Hyperspectral Imaging

#EVENTS

20TH ANNUAL MEETING OF THE GERMAN SOCIETY FOR COMPUTER- AND ROBOT-ASSISTED SURGERY (CURAC) 2021

September 16 – 18, 2021 | Virtual

- Thomas Neumuth | Program Committee; Session Chair: Workflow Software Solutions for the OR
- Claire Chalopin | Program Committee; lecture: Hyperspectral Imaging for Monitoring the Patient's Condition and Identifying Anatomical Structures in Visceral Surgery; Session Chair: Abdominal Surgery

CAREER WORKSHOP "ONKOLOGIE 360 GRAD"

September 17, 2021 | Leipzig

- Thomas Neumuth | Lecture: Die Medizin der Zukunft: Technik vs. Mensch

THE CARDIOVASCULAR AND INTERVENTIONAL RADIOLOGICAL SOCIETY OF EUROPE (CIRSE) SUMMIT 2021

September 25 – 28, 2021 | Virtual

- Xinrui Zhang | Lecture: Towards Robot-assisted Application of Focused Ultrasound-induced Cavitation

55TH ANNUAL CONFERENCE OF THE GERMAN SOCIETY FOR BIOMEDICAL ENGINEERING (BMT 2021)

October 5-7, 2021 | Hannover

- Andreas Melzer | Keynote chair: Ultrasound Diagnostics, MRI Safety
- Thomas Neumuth | Keynote chair: Models of Personalized Medicine – Advanced Tools and Methods, Models of Personalized Medicine – Connectivity, Modellgestützte Personalisierte Medizintechnik
- Johann Berger| Lecture: Accuracy Evaluation of Two Co-registered Mobile Robotic Systems for Image Guided Interventions
- Richard Bieck| An Interactive System for Muscle and Fat Tissue Identification of the Lumbar Spine Using Semantic Segmentation
- Jan Gaebel and Stefan Franke | Lecture: The Digital Twin: Modular Model-Based Approach to Personalized Medicine
- Ivan Matyash | Lecture: Accuracy Measurement of HoloLens2 IMUs in Medical Environment

MEDICAL DEVICE MR SAFETY SPECIALIST | MRSS – GERMANY

October 7 – 9, 2021 | Virtual

- Andreas Melzer | Workshop: Hands-on Course on MR Safety with an RF-induced Heating Experiment

SCHLAGANFALL-ALLIANZ-SACHSEN-ANHALT (SASA) SYMPOSIUM

October 9, 2021 | Halle

- Galina Ivanova | Lecture: Schlaganfallnachsorge mit digitaler Unterstützung – Chancen und Herausforderungen

EIFSES 17TH WORLD CONGRESS OF ENDOSCOPIC SURGERY

November 24 – 27, 2021 | Barcelona, Spain

- Andreas Melzer | Course director: Ultrasound

107TH SCIENTIFIC ASSEMBLY AND ANNUAL MEETING OF THE RADIOLOGICAL SOCIETY OF NORTH AMERICA (RSNA 2021)

November 28 – December 2, 2021 | Chicago, United States of America

- Andreas Melzer | Lecture: Magnetic Resonance Imaging-guided Focused Ultrasound Hyperthermia Sensitize Prostate Cancer To Radiation Therapy In Xenograft Mice Model

CASUS ANNUAL WORKSHOP 2021 | DIGITAL TWINS OF COMPLEX SYSTEMS

December 6-9, 2021 | Virtual

- Thomas Neumuth | Workshop: Digital Patient Twins and Model-based Medicine

PROJECT- AND COOPERATION WORK

MR-BIOPSY FINAL MEETING WITH VDI E.V. AND PROJECT PARTNERS

June 9, 2021 | Online

- Martin Reich | Presentation of the final results of the project

COMPASS PROJECT WORKSHOP WITH PARTNERS

August 2-4, 2021 | Leipzig

- Implementation of project contents and partial demonstrators at the Leipzig site, consolidation of individual results of the project partners

WORKSHOP FOR COMPREHENSIVE CANCER CENTER (CCC) CENTRAL GERMANY

August 31, 2021 | Jena

- Andreas Melzer on image-guided high intensity focused ultrasound in the non-invasive treatment of various benign and malignant lesions

FINAL PROJECT MEETING – LYSIS

September 1, 2021 | Leipzig

- Final meeting with project partner Diaspective Vision

#EVENTS

FOUNDING CEREMONY OF THE FIRST SAXON CENTER FOR ROBOT-ASSISTED AND NAVIGATED SURGERY

September 29, 2021 | Leipzig

- Andreas Melzer | Introductory lecture

FINAL PROJECT MEETING – AUTOCUFF

September 28, 2021 | Leipzig

- Reinhard Fuchs | Concluding project meeting with industrial partner Asskea

POSTSTROKE MEETING WITH COOPERATION PARTNERS

Oktober 6, 2021 | Leipzig

- Start of the clinical trial with the system set up by the PostStroke team

SHAPING THE FUTURE OF HEMATOLOGY

October 8, 2021 | Leipzig

- Thomas Neumuth | Opening remarks & Moderation, together with Uwe Platzbecker (UKL)
- Alexander Oeser, Anne Sophie Kubasch (UKL) | Therapeutic Challenges on the way to precision medicine, Introduction KAIT Tool

MULTISWIR PROJECT MEETING WITH PARTNERS

October 14, 2021 | Virtual

- Annekatrin Pfahl |Presentation: Spectral Imaging for Medical Applications

AIQNET PROJECT MEETING

November 16, 2021 | Leipzig

- Johann Berger, Juliane Neumann | Meeting with Project Partner TZM, project content and planning

POSTSTROKE MEETING

December 14, 2021 | Leipzig

- PostStroke project group and project partner at the Department of Neurology (UKL) | First quality circle for monitoring of the study

#UNIVERSITY COURSES

LEIPZIG UNIVERSITY

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

Development of Medical Products
Faculty of Mathematics and Computer Science
Lecture

Fundamentals of Medical Informatics and Introduction to Medical Documentation
Faculty of Mathematics and Computer Science
Lecture

Introduction to Computer Assisted Surgery for Medicine Students
Faculty of Medicine
Lecture

Problem-based Learning
Faculty of Medicine
Course

Structured System Innovation in Medicine
Faculty of Mathematics and Computer Science
Lecture and seminar

Teaching Export Master Module on Medical Informatics
Faculty of Mathematics and Computer Science
Lecture and seminar

LEIPZIG UNIVERSITY OF APPLIED SCIENCES (HTWK)

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 and seminar

#GRADUATIONS

MASTER DEGREES

Gary Cooney
„The discrimination of human and animal blood using hyperspectral imaging and chemometric methods“
Leipzig University

Saskia Mareen Heinrich
„Kalibrierung und nachgelagerte Verarbeitung eines Multi-Kamerasystems auf Basis des Azure Kinect DK und einer FLIR Boso Thermabild Kamera“
Chemnitz University of Technology

Lisa Kießling
„TraumaFlow: Workflow-Management-based Assistance System fort he Treatment of Patients in the Trauma Room“
Leipzig University

Anna Schröder
„Einsatz Künstlicher Neuronaler Netze zur Untersuchung hyperspektral aufgenommener histologischer Schnitte mit ösophagogastrischen Krebszellen“
Leipzig University

Ludwig Wermke
„Entwicklung eines Optimierungsalgorithmus für die Planung von Lappenplastiken“
Leipzig University

BACHELOR DEGREE

Lisa Diekmann
„Entwicklung eines Assistenz-Systems für die virtuelle Pfadplanung in der minimalinvasiven HNO-Chirurgie auf Basis von Strategien der robotischen Raumexploration“
Leipzig University

Johannes Kindler
„Analyse und Implementierung einer netzwerkbasierten Videoübertragung für medizinische Anwendungen“
Leipzig University of Applied Sciences (HTWK)

Felix Weber
„Herstellung und Validierung von in-vitrow Thromben zur Integration in ein Gefäßmodell“
Ernst Abbe University of Applied Sciences (EAH) Jena

DOCTORATE DEGREE

Marja Gareis
„Retroperspektive Analyse zur Compliance einer simultanen adiochemotherapie bei Patienten im Kopf-Hals-Tumoren. Validierung der Vorhersage mit Hilfe von Computerassistenzsystemen“
Leipzig University

Marianne Maktabi
„Auswertung von chirurgischen Arbeitsabläufen als Zeitreihe mit Hilfe von spektralen Analyse-verfahren und deren Anwendung im klinischen Alltag“
Leipzig University

Max Rockstroh
„Herausforderungen bei der Prozessunterstützung im Operationssaal Aktivitätserfassung und Datenspeicherung als Grundlage zur Erkennung des chirurgischen Prozesses“
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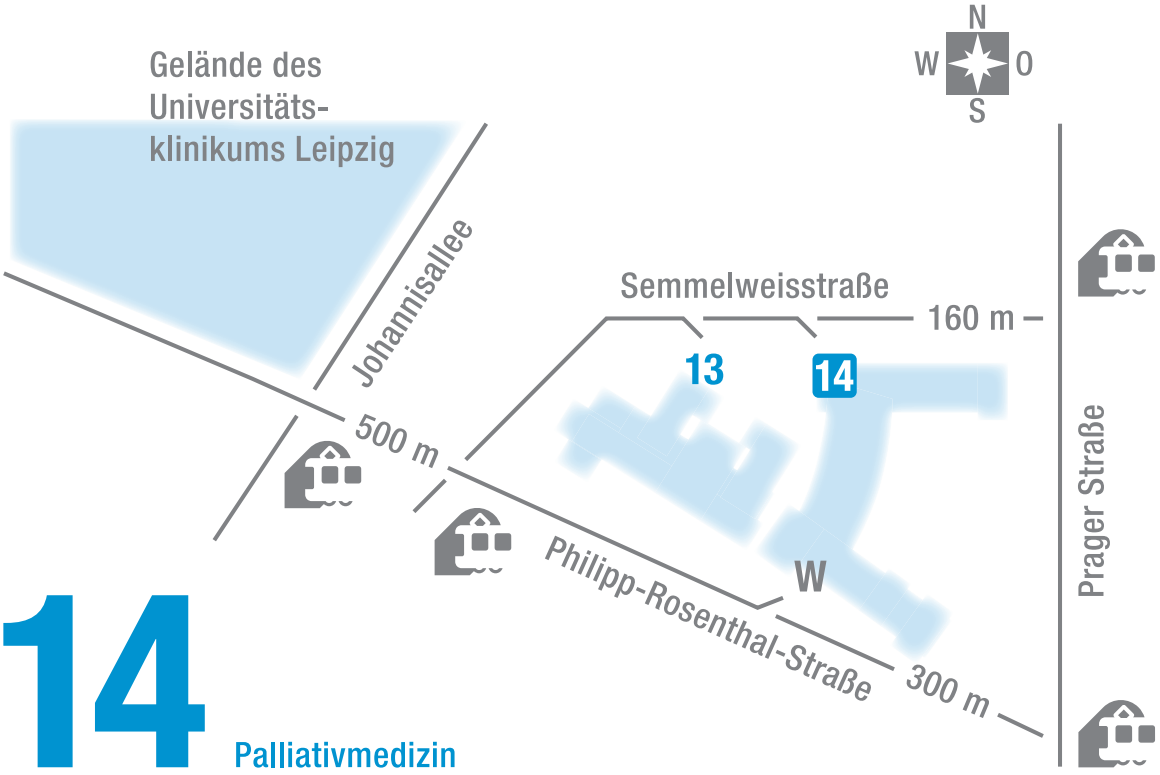

14 Palliativmedizin

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