ICCAS #ANNUAL_REPORT.2019
INNOVATION CENTER COMPUTER ASSISTED SURGERY
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Dear Ladies and Gentlemen,

In 2019 the total number of ICCAS employees increased from 77 to 82. Due to the significant size ICCAS has received, we decided to create two joint divisions: Computer-Assisted Interventions and Model-Based Medicine. They are working interrelated and closely together towards the greater goal of the ultimate intelligent hybrid operating room for smart medical technologies in surgical and interventional care.

Six new projects were launched with a total value of more than eight million euros. Two new BMBF projects began in the field of MR guided interventions, focusing on stent implantation and thrombosis treatment. There were notable developments in the IMPACT and SONO-RAV BMBF projects, with preclinical studies being carried out. In the field of hyperspectral imaging, there was remarkable success in clinical application together with the Department of Visceral Surgery. The results of the MoVE project were presented at MEDICA. The newly developed Service-Oriented Device Connectivity (SDC) family of standards, in whose development ICCAS was involved, were presented by OR.Net e.V. at the DMEA. ICCAS showcased its results at its own exhibition stands, including at the BMWi’s Innovation Day for SMEs, at SMIT and the BMT, and at the EUFUS and ISTU joint symposium in Barcelona.

Numerous ICCAS events offered networking opportunities and brought current research topics into focus. In March, regional companies and authorities met for a university transfer event at ICCAS. ICCAS also organized a doctoral workshop on the medical campus and the 6th international Digital Operating Room Summer School which attracted participants from five nations. In October, we discussed the application of artificial intelligence applications with the Chairman of the German Ethics Council at the University Hospital. Furthermore, ICCAS was visited by international delegations as part of university exchange programs as well as by Rafael Laguna de la Vera, founding director of the Leipzig-based German Agency for Disruptive Innovation (SprinD).

A great success is the continuation of our research center as an institute at the Leipzig University’s Faculty of Medicine, which is now planned for 2020.

We would like to thank everyone involved for the successful year 2019 and are already looking forward to the new year. One highlight will be the BMT 2020 in Leipzig, to which we cordially invite you.

Prof. Dr. Andreas Melzer
Prof. Dr. Thomas Neumuth
Congratulations! This year the Innovation Center for Computer-Assisted Surgery celebrates its fifteenth anniversary. I congratulate the ICCAS Board and the entire team of researchers, clinicians and staff who have made this milestone possible. Founded in 2005 as a ‘Centre for Innovation Competence’, ICCAS started out with two research groups and over time developed into an innovative research centre with six different specialisations. Over the past 15 years, it has attracted some 45.8 million euros in external funding and generated around 600 publications. Today ICCAS enjoys a national and international reputation as a research centre at Leipzig University.

With its unique focus, this research centre boasts a number of features that make it stand out from the crowd: ICCAS develops various digital technologies for clinical settings; it is an interface between research and application, thus promoting interdisciplinary collaboration between medical professionals, computer scientists and engineers; and it also addresses issues of social relevance, such as how artificial intelligence can be put to efficient use in healthcare. ICCAS is an established and certified partner for medical engineering companies. Its research findings facilitate the work of clinical personnel, increase treatment safety and lead to more economical processes in everyday clinical practice. ICCAS supports the medical disciplines in meeting the current challenges of digitisation and raises their profile at state, federal and international level. The Minister President of Saxony, Germany’s Federal Minister of Health, and the European Commissioner for Humanitarian Aid and Crisis Management have all visited ICCAS, where they found out about the current state of research.

Research findings are transferred via clinical departments, teaching and research institutions in cooperation with numerous partners at national and international level. ICCAS is thus an integral part of Leipzig’s wider University Medical Centre, which boasts around 50 institutes, divisions and departments. As the largest educational institution for medicine and pharmacy in Saxony, our faculty also makes an important contribution to teaching with the doctoral workshops and summer schools run by ICCAS.

My sincere thanks go to all those involved who, with their tireless effort, personal dedication and thirst for research, have all contributed to this successful performance. This includes our partners in the scientific community as well as those from politics and industry. Looking ahead, I hope that ICCAS will be involved in a wide range of new research projects, all with the aim of ensuring the well-being of patients.

Professor Michael Stumvoll
Dean of the Faculty of Medicine
#INSTITUTIONAL FACTS

2009
- ICCAS colloquium on Computer Assisted Surgery launched
- Establishment of the IRDC – ICCAS as a pioneer and cooperation partner

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

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

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

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 ‘NVS – 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
- 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

2014
- Launching of cooperation with several scientific and clinical institutions
- Tenth anniversary of ICCAS with second DORS and ICCAS International Symposium
- Project OR.Net: Presentation of results in the complete demonstrator
- NEW RESEARCH AREAS: Noninvasive Image Guided Interventions (Prof. Andreas Melzer), Multimodal Intraoperative Imaging (Dr. Claire Chalopin)
- Clinical Advisory Board founded
- New Advisory Board members: Prof. Ron Kikinis and Prof. Günter Rau

2015
- ICCAS meets Federal Chancellor Angela Merkel at Digital Summit 2017
- 4th Digital Operating Room Summer School consolidates its unique feature
- EUFUS 2017 & Preconference Workshop Experimental FUS and HIFU take place in Leipzig
- Successful non-invasive treatments with HIFU at Leipzig University Hospital
- RESEARCH AREA Life Support Systems with projects IMPACT and EMU launches
- Start of projects European Modular Field Hospital, PAPA-ARTIS and MoVE

2016
- ICCAS welcomes Saxony’s Prime Minister Michael Kretschmer
- 5th Digital Operating Room Summer School inspired international participants
- ICCAS takes part at the Surgical Robot Challenge of the Hamlyn Symposium in London
- ICCAS hosts Steering Committee Meeting of the European Modular Field Hospital project
- ICCAS invites to the 17th Annual Conference of the CURAC-Society
- Launch of projects: ENSEMBLE, COMPASS and LYSiS
- EU Commissioner for Humanitarian Aid & Crisis Management Christos Stylianides visits ICCAS
- ICCAS organizes the ‘FutureMedTechnologies’ doctoral workshop and transfer meeting
- OR.Net e.V. presents the SDC-Standard at DMEA 2019
- 6th Digital Operating Room Summer School successfully performed

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- Launch of projects MR-Stents, MR Thrombosis, MOMENTUM and MPM

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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.
HIGHLIGHTS

FMT-TRANSFERMEETING AT ICCAS | MARCH 2019
Leipzig University’s Prorectorate for Development and Transfer and the Leipzig Chamber of Commerce and Industry invited to the FutureMedTechnologies (FMT)-Transfer Meeting at ICCAS. Representatives of regional companies, local municipalities and science gathered to explore ICCAS’ research and find common interests.

FMT-DOCTORAL WORKSHOP | MARCH 2019
In cooperation with the Economic Development Corporation of Leipzig City ICCAS hosted the FutureMedTechnologies (FMT) – doctoral workshop on the Leipzig medical campus. The event addressed regional companies with their products and job offers and PhD students, who presented their current research work.

PUBLICATION OF THE SEOUL DECLARATION | APRIL 2019
Professor Andreas Melzer is co-editor of the ‘Manifesto for Ethical Medical Technology’ published in the MITAT Journal, April 2019. The foundation for the declaration was laid with the presentation and signing during the SMIT 2018 conference in Korea. It should serve as an ethical guideline for the medical device development and appropriate clinical use.

6TH DIGITAL OPERATING ROOM SUMMER SCHOOL – DORS | AUGUST 2019
Participants from 5 nations experienced an intensive training course during the sixth ICCAS Digital Operating Room Summer School (DORS). The guests were given a detailed look at the work of surgeons at the Leipzig University Hospital and Heart Center and were able to lend a hand in training modules.

VISIT OF ‘SprinD AGENCY’ | AUGUST 2019
ICCAS welcomed the founding director of the Leipzig-based ‘Agency for Disruptive Innovation (SprinD)’ Rafael Laguna de la Vera to present the latest developments in medical technology and medical informatics.

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Kids from the UKL-holiday program MEFALE visited ICCAS.

November 11 – 19, 2019

In December, ICCAS launched the BMBF-funded project Models for Personalized Medicine (MPM). The aim is to create a scientific-methodological basis for future model-based, personalized cancer treatments in close cooperation with regional industry partners and clinical users. Principal investigator is Prof. Thomas Neumuth.

MPM

In the BMBF-funded joint project, suitable concepts for the continuous integration of innovative networking technologies in emergency care and accident medicine will be developed and evaluated to improve treatment processes from the place of use to the hospital. ICCAS is the project coordinator. The kick-off meeting took place at ICCAS in November 2019. Principal investigator is Prof. Thomas Neumuth.

MOMENTUM

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PROJECT LAUNCHES

MR-STENTS AND MR-THROMBOSIS

The two BMBF-funded projects started in early 2019. Aim of the project MR-Stents is the worldwide first Magnetic Resonance (MR)-guided stent implantation. The project MR-Thrombosis-Theranostics deals with the research and development of the worldwide first Magnetic Resonance (MR)-guided diagnosis and minimally-invasive therapy of thromboses. Principal investigator is Prof. Andreas Melzer.

BMT 2019

| SEPTEMBER 25 – 26, FRANKFURT A. M. |

IMPACT with an exhibition booth on the topic Electrical Impedance Tomography (EIT) for patient-specific visualization of lung function.

MEDICA 2019

| NOVEMBER 18 – 21, DÜSSELDORF |

Exhibition booth on device networking and automated operating room.

INHOUSE EVENTS

January 16, 2019

Senior Academy of Leipzig University on excursion at ICCAS.

January 24, 2019

ICCAS Status Seminar 2018 with opening words from the Medical Faculty Dean Prof. Dr. Christoph Josten.

February 20, 2019

Kids from the UKL-holiday program MEFALE visited ICCAS.

November 11 – 19, 2019

ICCAS welcomed the Dean Mount Kenya Medical School, Dr. Juliet Gathera, for a job shadowing at ICCAS.

SMIT 2019

| OCTOBER 10 – 13, HEILBRONN |

Participation with scientific lectures, science slam presentations and a robot-demo.

DIGITAL SUMMIT 2019

| OCTOBER 28, DORTMUND |

Prof. Thomas Neumuth about AI-based digital platforms in research in an expert panel of industry and science.
**JULIANE NEUMANN** received the best paper award of the Future-Med-Technologies doctoral workshop for her work on optimizing work processes in operating rooms.

**C. Martin Reich** took second place at the science slam of the congress of the international Society for Medical Innovation and Technology (iSMIT) in Heilbronn. He amusingly showed the expert audience what is all about ‘The Sexiness of MRI-guided Interventions’.

**DR. CLAIRE CHALOPIN** successfully completed her habilitation process. Her postdoctoral thesis deals with the technical development of intraoperative 3D ultrasound with contrast medium and dynamic infrared thermography (DIRT) for neurosurgery.

She has been appointed member of the scientific advisory board of the newly founded EU-Sano Centre for Computational Personalised Medicine in Krakow (Poland).

**PROF. DR. ANDREAS DIETZ** has been elected President of the German Society for Otolaryngology, Head and Neck Surgery (DGHNO). He will chair the Society for one year.

**JAN GAEBEL** won the poster prize at the 15th Leipzig Research Festival for Life Sciences 2019 in the category Computer Assisted Surgery for his work on ‘Integrated System Architecture for Model-Based Decision Support in ENT’.

**MARIANNE MAKTABI** won the poster prize at the joint conference of the societies: ‘Mitteldeutsche Gesellschaft für Gastroenterologie’ (MGG) and ‘Mitteldeutsche Chirurgenvereinigung’ (MDCV) for her work on ‘Hyperspectral Imaging during esophagectomy for the measurement of ischemic conditioning effects of the gastric conduit’.

**PROF. DR. ANDREAS MELZER** was elected a fellow of the British ‘Academy of Medical Sciences’. The Academy is an independent institution in the United Kingdom representing the diversity of medical science.

He has been appointed visiting professor by the National Cancer Center Graduate School of Cancer Science and Policy in South Korea.
#RESEARCH DIVISIONS
AND RELATED RESEARCH AREAS

#LIFE_SUPPORT_SYSTEMS

#INTRAOPERATIVE_MULTIMODAL_IMAGING

#ROBOTICS

#IMAGE_GUIDED_FOCUSED_ULTRASOUND

#MR_GUIDED_INTERVENTIONS

#MODEL_BASED_AUTOMATION

#DIGITAL_PATIENT_MODEL

Interrelated divisions: #Computer_Assisted_Image_Guided_Interventions #Model_Based_Automation_and_Intelligent_OR
Research in the division of image-guided interventions 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.

DIVISION LEADER
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 interventions.’

SCIENTIFIC STAFF
Nikolaos Bailis, Johann Berger, Julian Donig, Denis Gholami Bajestani, Felix Girrbach, Erwin Iimmel, Lisa Landgraf, Andreas Melzer, Ina Patties, Annekatrin Pfahl, C. Martin Reich, Upasana Roy, Andreas Seifert

SELECTED PUBLICATIONS
**SCIENTIFIC RESEARCH AREAS AND RELATED PROJECTS:**

**#IMAGE_GUIDED FOCUSED ULTRASOUND:**
- **SONO-RAY** | Tumor Therapy Combined by MR-Guided Focused Ultrasound and Radiation Therapy | Founding: META-ZIK of the Federal Ministry of Education and Research (BMBF)
- **CURE-OP** | Oncological Therapy Platform for Combined Ultrasound Radiation Therapy | Founding: Federal Ministry of Education and Research (BMBF)
- **Imaging Robotics** | Concepts for Robotic-guided Focused Ultrasound Hyperthermia and Radiation Therapy in the Clinic | Founding: Saxony’s Ministry for Sciences and Arts (SMWK)

**#MR_GUIDED_INTERVENTIONS:**
- **MR-Biopsy** | MR Safe Flexible Biopsy Forceps for Minimally Invasive Tissue Sampling | Founding: Federal Ministry of Education and Research (BMBF)
- **MR-Thrombosis** | MR-guided Minimally-Invasive Diagnostics and Therapy of Thrombosis | Founding: Federal Ministry of Education and Research (BMBF)
- **MR-Stents** | MR-Guided Stent-Implantation | Founding: Federal Ministry of Education and Research (BMBF)
- **MRgFUS in the Treatment of Uterine Fibroids** – collaborative project with UKL
- **MRgLIFUP** | Neuroradulation Induced by Transcranial Focused Ultrasound (tFUS) Measured with EEG – collaborative project with Max-Planck-Institute and Fraunhofer IBMT

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

The Sono-Ray project, a joint project of ICCAS (Leipzig) and OncoRay (Dresden) funded by BMBF, started in October 2016 to investigate effects of focused ultrasound (FUS) at the molecular level of cancer cells with the goal to radiosensitize tumor cells by mild heating with low intensity FUS to improve the radiation treatment. FUS describes a unique technique using ultrasound beams to heat a target tissue inside the body in a non-invasive way via image-guidance and quantifiable temperature control in real-time due to magnetic resonance thermometry. Therefore, low intensity FUS displays for the first time a tool to heat only the target region avoiding tissue necrosis and without needle incisions or heating of surrounding tissue structures.

Intensive analysis on in vitro 2D cell cultures started and different in vitro systems for high throughput FUS treatment ultrasound penetrable 96-well cell culture plates were developed in cooperation with Fraunhofer IBMT (St. Ingbert). Prostate cancer cells, glioblastoma and head and neck cancer cell lines were treated with FUS and RT using in vitro systems and the effects on metabolic activity, DNA damage, cell cycle and the apoptotic levels were determined. To realize the treatment in a small animal model, all steps towards the MRI-guided FUS and CT-guided RT were full-filled in strong cooperation with Fraunhofer IZI (Leipzig). A dedicated MR-compatible FUS in vivo system was installed into a 7T Bruker preclinical MRI and tested. To control the temperature during the FUS intervention, PRF based MR-thermometry was evaluated in the preclinical MRI to run in parallel to the FUS treatment.

In vitro results showed a significant reduction in the metabolic activity in the prostate cancer cell line PC-3 three days after the FUS and RT combination treatment with a higher apoptosis level, increased amount of DNA double strand breaks and more cells in Sub-G1 cell cycle phase indicating the induction of programmed cell death while avoiding necrosis.

First in vivo experiments demonstrated the feasibility of MRI-guided moderate heating at low FUS intensities in tumor xenografts. The reduction of potential hypoxia and decrease in tumor growth after FUS and RT will be investigated in 2020.

To conclude, radiosensitizing events of low intensity FUS at moderate temperatures in a range of 41-46°C could be demonstrated in vitro in prostate cancer cells, currently indicating dependence on the cancer cell identity. Further in vivo experiments are needed to pro-
Computer-assisted Image-guided interventions

launched in January 2019.

with the french company Theraclion which
in cooperation of FUS into the radiation room led to the
-robotic arms to hold one therapeutic and one
implementing robotic solutions with two Kuka
and RT treatment, first steps were realized by
ding the clinical translation of a combined FUS
of FUS on tumor hypoxia and perfusion. Regar
ve our in vitro findings and verify the imapct
is developing motion algorithms to ensure
A Kuka LBR iiwa robotic arm was combined
connected with IEEE 11073 SDC standard.

CURE-OP - COMBINATIONAL ULTRASOUND AND RADIOTherapy
ENHANCED ONCOLOGY PLATFORM

The aim of CURE-OP is to develop the first
commercially available high intensity focu-
sed 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 cava-
tion) enabling different types of cancer po-
lytherapy.

A Kuka LBR iiwa robotic arm was combined
with Theracions HIFU treatment head. ICCAS
is developing motion algorithms to ensure
able acoustic coupling of the treatment
head.

For the integration of the CURE-OP hardware
into a radiotherapy facility, the current work-
flow was recorded during a site visit at the de-
partment of radiology of the University of
Leipzig Medical Center.

IMAGING ROBOTICS

The robotics group at ICCAS aims for the inte-
gration of collaborative robotic systems into the
clinical domain. The collaborative aspects of
such systems (direct interaction with the ro-
bots during autonomous movement) provide
promising interaction and workflow concepts
that reduce complexity and ease the handling
of the robots during surgical tasks. The main
research focus lies on the development of an
integrated platform for an interconnection of
collaborative robotics with other medical de-
vices. Using the IEEE 11073 SDC standard for
medical device connectivity, a first demonstra-
tor with two KUKA lbr iiwa 7 R800 robot arms
and an augmented reality based tablet applica-
tion was implemented. The system is currently
under evaluation for the use case of different
therapeutic and imaging ultrasound regimes in
the projects Sono-Ray and Cure-OP.

MR-GUIDED FUS IN THE TREATMENT
OF UTERINE FIBROIDS

Since 2017, we have successfully established
a fibroid- treatment- center in our hospital
(Leipzig University Hospital). Our aim is to
provide an optimized individual treatment to
patients with symptomatic uterine fibroids,
offering all modern therapy options inclu-
ding MR-g-HIFU (Profound medical Sonalleve
MR-HIFU System). To date, over 130 patients
have been screened and with 26 of them re-
cieving a MR-HIFU-Treatment. The patients
were treated in a clinical setting, under anal-
gesia and sedation. All patients were dischar-
ged on the next day after treatment without
any significant complaints. Symptom control
was accomplished for the majority of the
patients and 2 successful pregnancies were
also achieved. In addition, a multisession HI-
FU-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 suggested that TFUS could
be used to non-invasively modulate neuronal
activity in humans (Legon et al. 2014). Poten-
tially, such modulation of brain activity allows
therapeutic applications (e.g. stroke, addicti-
on, Parkinson). We used a custom-made ul-
trasound system (Fraunhofer IBMT) that can
be synchronized with EEG recordings. This
device allows to adjust the focus depth, and
thus to position a focal ultrasound spot in a
given volume with high spatial accuracy. Our
preliminary data acquired with four scalp
electrodes shows a differential modulation
of EEG activity depending on the stimulation
depths, i.e. synchronization for focus 30 mm,
desynchronization for 100 mm. Currently, an
experimental trial is in progress, with denser
EEG recordings to further validate our results.

MR SAFE FLEXIBLE BIOPSY FORCES
FOR MINIMALLY INVASIVE TISSUE
SAMPLING – MR-BIOPSY

Endomyocardial biopsy (EMB) is a procedure
for diagnosis of tumor, acute myocarditis or
transplant rejection. EMB is usually conduc-
ted using X-ray fluoroscopy implying unfavor-
able ionizing radiation, nephrotoxic contrast
agents, and poor soft tissue contrast. Goal of
the joint project MR-BIOPSY is to overcome
these disadvantages by transfer of EMB pro-
cedures into the magnetic resonance imaging
(MRI) environment. Therefore, a worldwide
first MR safe, flexible biopsy forceps cont-
aining a combination of novel MRI and X-ray

Custom-made ultrasound system (Fraunhofer IBMT) that can be synchronized with EEG recordings.
Marker is developed. Feasibility of the intervention is ensured by development of a corresponding clinical workflow and conformity of the components with MR safety regulations like ASTM and ISO standards.

Performed investigations already shown the feasibility of a non-metallic, non-magnetic and non-conductive biopsy jaw. In the current step, metal-based passive markers combined with radiopaque particles are tested under fluoroscopy and real-time cardiac MRI sequences. To evaluate the visibility and usability in a realistic environment, a phantom consisting of a porcine heart connected to a life-size silicone model of a human arterial vessel system was manufactured.

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

Coronary heart disease and associated myocardial infarction is one of the main causes of death in Germany. The recommended therapy by the National Disease Management (NVL) guideline is minimally invasive catheter-guided stent implantation, which is usually performed using X-ray fluoroscopy. As a high risk group, children with congenital heart disease (e.g. coarctation of the aorta) are commonly treated by stent implantation. The aim of project MR-STENTS, funded by ‘KMU-innovativ: Medizintechnik’ of the Federal Ministry of Education and Research (fund no. 13GW0288D), is to develop a MR-guided stent intervention. MR imaging offers a promising alternative to fluoroscopy guidance, benefitting from excellent soft tissue contrast, possibility of real-time imaging, as well as absence of ionizing radiation. Novel MR markers are developed at ICCAS to visualize instruments during MR-guided stent implantation. These markers are based on resonant circuits and work with developed corresponding MR sequences. Additionally, a clinical workflow using a novel interaction setup is developed. This setup ensures real time control and communication during MR-guided interventions by the physician. In the further course of the project, the findings should serve as framework for treatment of additional use-cases like stenting of the esophagus, liver, and lung.

**MR-GUIDED MINIMALLY INVASIVE DIAGNOSTIC AND THERAPY OF THROMBOSIS – MR-THROMBOSIS-THERANOSTICS**

Thrombi are clots resulting from intravascular blood coagulation – a protective mechanism of the human body. Blood clots disturb the physiological blood flow and can become detached as thromboembolism. In worst the case this could lead, for example, to a life-threatening pulmonary embolism. Thrombosis can be treated by chemical, surgical or minimally invasive techniques. The latter is usually performed under X-ray-based fluoroscopy, using ionizing radiation and nephrotoxic contrast agents. Especially the usage of ionizing radiation bears certain drawbacks for both, medical staff and patients. Particularly, pregnant women and their unborn children could benefit from a translation of minimally invasive thrombosis therapy into the MR environment. MR-guided interventions would eliminate health hazards associated with X-ray guidance. Next to excellent soft tissue contrast, MR imaging offers the advantage of adjustable tissue weighting, real-time and temperature-sensitive imaging. These features can be used for visual acquisition of thromboembolism trapped by implanted vena cava filters (VCF), and therefore lead to better decisions regarding the further course of the treatment. However, to ensure conformity with regulations regarding MR safety and biocompatibility, novel medical instruments and corresponding workflows need to be developed.

Goal of the joint project MR-Thrombosis-Theranostics is the investigation of a MR-guided medical intervention for the diagnosis and treatment of thrombosis. ICCAS focuses on diagnosis, minimally invasive therapy of thrombosis and implant based prevention of thromboembolisms. Therefore, nitinol-based baskets and VCFs are developed using optimized manufacturing methods. Nitinol baskets allow interventional removal of formed blood clots, whereas implanted vena cava filters prevent the migration of thromboembolism. Both devices have to be designed and produced in a way to ensure MR safety and visibility. The targeted MR marker concept uses resonant circuits to locally enhance the MR signal, rather than the commonly used mechanism of disturbing artifacts caused by shielding properties. To ensure feasibility and sufficient visualization of the devices, suitable MR sequences and adjusted clinical workflows are developed.

In further course of the project, patient model studies using a silicone-based model of a human arteriovenous vessel system, including right side of the heart, are performed. Therefore, anonymous medical imaging data is segmented, 3D rendered and then used for an additive manufacturing process in order to create a realistic patient model.
Research in the division of model-based medicine pioneers the development of biomedical information systems 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.

DIVISION LEADER
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
Richard Bieck, Claire Chalopin, Stefan Franke, Reinhard Fuchs, Jan Gaebel, Christoph Georgi, Hannes Köhler, Patrick Korgtso, Dirk Lindner, Marianne Maktabi, Tim Meschke, Julia Mrongowius, Juliane Neumann, Thomas Neumuth, Alexander Oeser, Max Rockstroh, Peter Salz, Dominic Schneider, Erik Schreiber, Michael Unger

SELECTED PUBLICATIONS


SCIENTIFIC RESEARCH AREAS AND RELATED PROJECTS:

#MODEL_BASED_AUTOMATION:
- Move | Modular Validation Environment for Medical Networks | Founding: Federal Ministry of Education and Research (BMBF)
- MOMENTUM | Mobile Medical Technology for Integrated Emergency Care and Accident Medicine | Founding: Federal Ministry of Education and Research (BMBF)
- COMPASS | Comprehensive Surgical Landscape Guidance System for Immersive Assistance in Minimally-Invasive and Microscopic Interventions | Founding: Federal Ministry of Education and Research (BMBF)
- ENSEMBLE | Development of a scalable and magnetic resonance (MR) compatible blood circulation model | Founding: Federal Ministry of Economic Affairs and Energy (BMWi) – ZIM-program

#DIGITAL_PATIENT_MODEL:
- Digital Patient- and Process Model | Founding: Federal Ministry of Education and Research (BMBF)
- PAPA-ARTIS | Paraplegia Prevention in Aortic Aneurysm Repair by Thoracoabdominal Staging with ‘Minimally-Invasive Segmental Artery Coil-Embolization’: A Randomized Controlled Multicentre Trial | Founding: European Union - H2020 - GA-Nr. 733203

#INTRAOPERATIVE_MULTIMODAL.Imaging:
- AutoSon | Automatic Navigated Intraoperative Ultrasound Imaging for Brain Tumor Removal | Founding: Federal Ministry of Economic Affairs and Energy (BMWi) – ZIM-program
- LYSIS | Innovative Imaging for Tissue Differentiation in Minimally Invasive Surgery | Founding: Federal Ministry of Education and Research (BMBF) – KMU-Innovative program

#LIFE_SUPPORT_SYSTEMS:
- EU-MFH | European Modular Field Hospital | Founding: General Directorate for European Civil Protection and Humanitarian Aid – Operations: ECHO/SUB/2016/739964/PREP14
- IMPACT | Mobile System for Emergency Medical Diagnosis and Monitoring of the Pneumothorax | Founding: Federal Ministry of Education and Research (BMBF) – KMU-Innovative program
- EMU | Ventilation System with Electrical Impedance Imaging to Monitor Patient Condition and to Optimally Ventilate the Patient | Founding: Federal Ministry of Economic Affairs and Energy (BMWi) – ZIM-program

MOVE – MODULAR VALIDATION ENVIRONMENT FOR MEDICAL DEVICE NETWORKS

Cross-vendor medical device connectivity based on the IEEE 11073 SDC standards family requires new strategies for testing which account for risks that stem from interoperability. Interoperability poses significant testing challenges especially for small and medium sized enterprises in terms of design and validation of new networked products.

We provide a modular simulation and test framework’s to simplify the development and the approval process for networked medical devices. The frameworks core is an SDC sandbox, which allows to simulate a large variety of medical devices and surgical procedures directly at the developer’s desk at low cost. Methods of machine learning and surgical process modeling have been used to simulate the behavior of medical devices in SDC networks. The simulation includes surgical work steps, the usage of devices during these work steps, discrete events, measurements, alerts, and even device failures. The pseudo randomization provides a lot of process variation and simultaneously ensures a sufficient reproducibility. Furthermore, in depth analysis and documentation of the network communication is realized.

With an extendable library of test scenarios as well as abstract and specific simulators, the MOVE framework supports development, interoperability testing, and regulatory approval for a large variety of medical devices and services.

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. The care processes are based primarily on the presence of medical-technical resources, for example, imaging units, vital monitoring and respiratory monitoring, and equipment for emergency interventions. However, these services cannot currently be made available for emergency medical care. Due to their complexity and size, many of these modalities are not suitable for mobi-
le use. As a result, there is a need to design strategic and technical concepts to deliver the fastest possible emergency medical care, thereby improving treatment processes from the scene of the accident to the clinic. The overall objective of the project is the development of integrated medical technology, which can be used in a mobile fashion along the process chain, not only in the hospital (e.g., trauma room, operating theater, intensive care unit), but also preclinically in a dynamic setting. The interconnected medical technology and IT systems are integrated into a common communication infrastructure across heterogeneous communication technologies, such as 5G, LTE, WiFi, and make their functionalities available via the infrastructure. The digital networking in the mobile point-of-care with medical diagnostic and therapy systems results in a significant improvement of the mobile treatment scenario. Thus, it is already possible to access medical resources and information from the hospital at the place of treatment and also in virtual environments during preclinical scenarios. The use of the new 5G communication technology and a central infrastructure for the transmission and analysis of the collected data supports both the coordinating offices (control center), the responders on the site of emergency and the clinical staff in the trauma centers. This should optimize processes for the benefit of the patient and improve the use of resources among the various user groups.

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. We are approaching surgical navigation from the standpoints of situation awareness, a theory from aeronautics and aerospace research, the cognition-guided surgery paradigm and autonomous robotics for navigation. A dual information processing cycle model performs situation comprehension and memory processing for the simulation of human-like behaviour. The model maintains a working memory of relevant information for a current navigation goal. Simulated and real navigation behaviour are compared to identify beneficial navigation support, e.g., directions, work steps, maps.

ENSEMBLE – DEVELOPMENT OF A SCALABLE AND MAGNETIC RESONANCE (MR)-COMPATIBLE BLOOD CIRCULATION MODEL

Artificial surgical phantoms enable surgeons to improve their skills and dexterity outside of real surgeries. For the training of catheter-based surgeries, a training model with a realistic vascular tree and an active blood circulation system is required. The project ENSEMBLE aims to provide such a phantom, by using CT images and automatically segmented blood vessel areas throughout combined data sets. The phantom should represent the density, thickness and elasticity of real vessel walls with a maximum degree of branching. Based on a set of multiple CT images, the automatic segmentation of the vascular system is to be performed by model-based segmentation algorithms, such as the greedy snake and statistic form models. Together with a pump and a blood-like fluid, the resulting 3D-representation will be used to manufacture an artificial vascular system.

DPM – DIGITAL PATIENT- AND PROCESS MODEL

The growing number of medical screening options and forms of treatment for complex diseases require more patient-specific therapy decisions and treatment processes that increase the chance of a better clinical outcome. Digital patient and process models integrated in clinical decision support systems address these problems. They represent the disease-specific therapeutic decision-making and therapy processes and are instantiated with patient-specific data for personalized medicine. Bayesian Networks are the basis for this model-based clinical decision support. They allow an objective representation of all causal relationships between the patient, the medical knowledge and the disease with its treatment options. After spending time creating formal decision models in close cooperation with clinical experts, the results were prepared for translation into clinical practice. In different technical environments and clinical applications, the model-based decision support was utilized to validate the functionalities for real-life clinical usage. A centralized app was created to integrate all relevant information entities and to be able to present patient models in their respective context for an optimal assistance to the interdisciplinary teams. Also, the creation and storage of models was enhanced with specialized tools that integrate modern information technologies.
PIMPAP – PATIENT-BASED INDIVIDUAL MODELING OF PARASPINAL COLLATERAL NETWORK PERFUSION AFTER SEGMENTAL ARTERY OCCLUSION

The repair of large thoracoabdominal aortic aneurysms employs extensive endovascular surgery with stent grafting. A successful intervention still poses risks of paraplegia or death due to ischaemic reactions in the spinal cord. The new MISACE procedure, employed to reduce these risks by preemptively closing supplying segmental arteries of the aorta, is yet to be supported by clinical guidelines. Inside the multi-centric clinical PAPA_Arts EU project, we are modeling the patient and his corresponding intervention process in a computational model to investigate the influence of varying MISACE parameters on the confluence of spinal perfusion and the clinical outcome. We are establishing a digital patient representation based on multimodal information at various stages of the MISACE staging as well as post-operatively after aneurysm repair. With the investigation of temporal changes of specific patient data (vital, pathological, and procedure parameters), we are abstracting the problematic to achieve a more generalised representation of the treatment process. Main patient parameters, e.g. demographic background, imaging data, anamnesis, and diagnosis were identified and the MISACE procedure was analysed using workflow and process analysis steps. Both the patient and the process model are then used to form a therapy model that is instantiated at for the PAPA_Arts trial.

AUTOSON – AUTOMATIC NAVIGATED INTRAOPERATIVE ULTRASOUND IMAGING FOR BRAIN TUMOR REMOVAL

Development of an innovative neuro-navigation system supporting the use of intraoperative ultrasound imaging. Intraoperative ultrasound (US) imaging is standardly used to guide the surgeon during brain tumor operations. It remains, however, not optimally integrated in the surgical workflow. The goal of this project was the development of a new neuro-navigation system to support the use of intraoperative US imaging in the neurosurgery.

A tool to automatically identify the parameters of image acquisition, for example, the probe and the penetration depth, was implemented in order to automate visualization processes. Moreover, an approach for the enhancement of the tumor boundary in the US images was developed. Both tools were successfully integrated within a demonstrator including the navigation system, a laptop and the US device which was tested in the operating room. Limitations in the exchange of information were observed.

LYSIS – DEVELOPMENT OF A LAPAROSCOPIC HYPERSONSPECTRAL IMAGING SYSTEM

Hyperspectral imaging (HSI) is a contactless and totally non-invasive optical imaging method which showed promising results for applications in the surgery. The goal of this project is the development of a laparoscopic system, including HSI, in order to be used during minimal-invasive operations.

A first prototype of a laparoscope including a miniaturized HSI camera and a compatible light source was developed. Since the time for the acquisition of HSI data requires several seconds, an approach to register the HSI information with videos was implemented. Moreover, machine learning methods for organ differentiation and tumor identification were evaluated on the HSI data of patients. The next step of the project is the evaluation of the prototype in the operating room based on resected tissue.

EUMFH – EUROPEAN MODULAR FIELD HOSPITAL

The project aims to explore how the medical capacity of the Union Civil Protection Mechanism can be improved. Different EU Member States combine their expertise and build a common deployable Emergency Medical Team (EMT) level 3 for disaster relief missions. ICCAS was commissioned with the conceptualization and provision of an electronic patient record (EPR) for EMTs. As first step, a comprehensive requirements analysis was conducted. Subsequently, a concept for an EPR was derived, taking the special demands (e.g. lightweight, high flexibility, robustness) of EMTs into account.

The EPR was tested during the MODEX exercises in Romania and Estonia. The participating personnel was interviewed, regarding suitability, performance and operational capabilities of the developed EPR. The EPR system was well received by the participants. 21 team members have been interviewed. 14 of them with medical roles (physicians and nurse) and seven of them with supportive roles (Management, Logistics, or Training). Three medical team leaders were among the 14 medical interview partners. All participants came from nine different European countries.

IMPACT – IMPROVED MULTIPARAMETRIC MONITORING OF BLUNT CHEST TRAUMA

The IMPACT project focuses on the development of a mobile miniaturized device for the assessment of pulmonary ventilation and the detection of pneumothorax in pre-clini-
Beginning of the text

EMU – VENTILATION SYSTEM WITH ELECTROIMPEDANCE IMAGING FOR MONITORING THE PATIENT’S CONDITION AND OPTIMAL VENTILATION OF THE PATIENT

In the EMU project, a combination of mechanical ventilation device and electrical impedance tomography (EIT) was developed in cooperation with Fritz Stephan GmbH. With the help of EIT, lung ventilation can be made visible and various ventilation parameters can be calculated. The system comprises a joint processing and display unit of the two devices, with the aim of improving the ventilation strategy for the patient. The application focus here is on neonatal ventilation.

The EMU project was successfully completed this spring. In the figure you can see a demonstrator of the future system. The created joint analysis and presentation of the various parameters allow for a more individual and precise setting of ventilation parameters.

First- and Senior Authorship


#PUBLICATIONS


CONFERENCES PROCEDINGS


# PUBLICATIONS


Zhang X, Unger M, Patties I, Landgraf L, Melzer A. In vitro radiosensitization of human cancer cells with focused ultrasound induced hyperthermia. 53rd Conference of the German Society for Biomedical Engineering (BMT). Frankfurt am Main, Germany; 2019.


#EVENTS

IN-HOUSE EVENTS

VISIT FROM SENIOR-ACADEMY
January 16, 2019 | ICCAS
- Erik Schreiber | demonstration of ICCAS’ ‘Intelligent OR’
- Jan Gaebel, Alexander Oeser | project demonstration: Digital Patient Model

15TH RESEARCH FESTIVAL FOR LIFE SCIENCES LEIPZIG
January 18, 2019 | Medical Study Center, Leipzig University
- Johann Berger | poster: ‘Towards Integrating Combined Radiation and Focused Ultrasound Therapy into the Clinical Domain’
- Reinhard Fuchs | poster: ‘Monitoring of Ventilation Delay with Electrical Impedance Tomography’
- Jan Gaebel | poster: ‘Integrated System for Clinical Decision Models’
- Hannes Köhler | poster: ‘Untersuchung des Einflusses der ischämischen Konditionierung auf die Oxygenierung des Schlauchmagens mittels intraoperativer Hyperspektral-bildgebung’
- Marianne Maktabi | poster: ‘Supervised Tissue Discrimination during Thyroid and Parathyroid Surgery Based on Hyperspectral Imaging’
- Julia Mroczkowski | poster: ‘Simulation Study on Electrical Impedance Lung Imaging with Partial Access to the Thorax’
- Alexander Oeser | poster: ‘Towards Semi-Automatic Generation of Bayesian Decision Networks in Oncology Using a Hybrid Modeling Approach’
- Michael Unger | poster: ‘Assessment of Automatic Perforator Detection in Infrared Thermal Images for MR-Guided Interventions with the Use Case Endomyocardial Biopsy’
- Xinrui Zhang | poster: ‘In Vitro Study of FUS Induced Hyperthermia and Radiation Therapy Combination Treatment on Cancer Cells’

ICCAS STATUS SEMINAR 2018
January 24, 2019 | ICCAS
Presentation of ICCAS’ research results and highlights in 2018

15TH MEFALE (MEIN FERIENABENTEUER LEIPZIG)
February 20, 2019 | ICCAS
Insight into ICCAS’ research work for pupils

FUTURE MED TECHNOLOGIES – PHD WORKSHOP AND INDUSTRY FAIR
March 5, 2019 | Medical Study Center, Leipzig University
- Johann Berger | lecture: ‘Integration of Combined Radiation and Focused Ultrasound Therapy into the Clinical Domain’
- Richard Bieck | lecture: ‘Cognitive Navigation Assistance in Minimally-Invasive Surgery’
- Jan Gaebel | lecture: ‘Modular Infrastructure for Decision Models in ENT Oncology’
- Marianne Maktabi | lecture: ‘Supervised Tissue Discrimination during Thyroid and Parathyroid Surgery based on Hyperspectral Imaging’
- Julia Mroczkowski | lecture: ‘Electrical Impedance Lung Imaging with Partial Access to the Thorax’
- Alexander Oeser | lecture: ‘Semi-Automatic Generation of Bayesian Belief Networks in Oncology Using a Hybrid Modeling Approach’
- C. Martin Reich | lecture: ‘Research and Development of a Forceps for MR-Guided Interventions with the Use Case Endomyocardial Biopsy’
- Max Rockstroh | lecture: ‘Herausforderungen bei der Prozessunterstützung im Operationssaal’
• Erik Schreiber | lecture: ‘An Electronic Patient Record for the European Modular Field Hospital’
• Michael Unger | lecture: ‘Assessment of Automatic Perforator Detection in Infrared Thermal Images’
• Xinrui Zhang | lecture: ‘In Vitro Focused Ultrasound Hyperthermia for Radiosensitization of Human Cancer Cells’

FUTURE MED TECHNOLOGIES - TRANSFERMEETING
March 5, 2019 | ICCAS
Project demonstrations to invited regional companies and municipalities accompanying funding- and collaboration-talks

VISIT FROM THE DIRECTORATE-GENERAL FOR EUROPEAN CIVIL PROTECTION AND HUMANITARIAN AID OPERATIONS (DG ECHO) IN THE SCOPE OF ICCAS’ EU-MFH PROJECT
March 6 – 7, 2019 | ICCAS
Presentation of ICCAS’ research groups

ICCAS-COLLOQUIUM
March 21, 2019 | University Hospital Leipzig
• Ernst Marlinghaus | invited lecture: ‘Transkranielle Puls Stimulation TPS bei Patienten mit Alzheimer Demenz’

GIRL’S DAY
March 28, 2019 | ICCAS
• Johann Berger, Marianne Maktabi, Juliane Neumann, Annkatrin Pfahl | Insight into medical informatics for female pupils

VISIT FROM KENYAN PARTNER UNIVERSITIES
June 26, 2019 | ICCAS
Project presentation and exchange about application-targeted project work with representatives from Kenyan Universities

6TH DIGITAL OPERATING ROOM SUMMER SCHOOL (DORS)
August 26 – 30, 2019 | ICCAS, University Hospital Leipzig, Heart Center Leipzig
Unique introduction to various topics of computer assisted medicine

VISIT FROM ‘GERMAN AGENCY FOR DISRUPTIVE INNOVATION’ AND LEIPZIG CITY
August 29, 2019 | ICCAS
Presentation of ICCAS’ innovative developments in the areas medical technology and informatics

DISCUSSION EVENT ‘SCIENCE CONTROVERSIAL’
October 7, 2019 | University Hospital Leipzig
• Thomas Neumuth | public discussion: ‘With AI against cancer - How Artificial Intelligence and Robotics Revolutionize Medicine’
• Stefan Franke, Alexander Oeser | presentation of ICCAS’ ‘Intelligent OR’ and the DPM

VISIT FROM BUCAMARANGA HEALTH CLUSTER
November 21, 2019 | ICCAS
Presentation of computer assisted surgery and funding programs discussion with Colombian healthcare representatives

CONFERENCES, SYMPOSIA, WORKSHOPS
W.O.M. GMBH
February 7, 2019 | W.O.M. WORLD OF MEDICINE GMBH, Berlin
• Thomas Neumuth | invited lecture: ‘Möglichkeiten der OR-Vernetzung’

ZUVERLÄSSIGE STROMVERSORGUNG FÜR DEN OP- UND INTENSIVBEREICH
February 13, 2019 | TÜV SÜD AG, München
• Stefan Franke | lecture: ‘Vernetzte Medizintechnik im Operationssaal’

48. JAHRESTAGUNG DER DEUTSCHEN GESELLSCHAFT FÜR THORAX-, HERZ- UND GEFÄSSCHIRURGIE (DGTHG) UND 51. JAHRESTAGUNG DER DEUTSCHEN GESELLSCHAFT FÜR PÄDIATRISCHE KARDIOLOGIE (DGPK)
February 16 – 19, 2019 | Wiesbaden
• Dr. Stefan Franke | lecture: ‘Next Generation OR’

25TH EUROPEAN CONGRESS OF RADIOLOGY (ECR)
February 27 – March 3, 2019
• Lisa Landgraf | poster presentation: ‘In Vitro Investigation of Combined Focused Ultrasound (FUS) Hyperthermia (HT) and Radiation Therapy (RT) for Future Use of Image Guided FUS and RT in the Clinic’
• Andreas Melzer | lecture: ‘TRANS-FUSIMO: Preliminary In-Vivo Animal Results of MR-Guided Focused Ultrasound of Liver under Respiratory Motion’

136. KONGRESS DEUTSCHE GESELLSCHAFT FÜR CHIRURGIE (DCK)
March 26 – 29, 2019 | Munich
• Claire Chalopin | invited lecture: ‘Deep Learning and Algorithms of Cancer Recognition via Hyperspectral Imaging’
• Hannes Köhler | poster presentation: ‘Evaluation of Ischemic Conditioning Effects of the Gastric Conduit with Hyperspectral Imaging (HSI)’
49. KONGRESS DER DEUTSCHEN GESELLSCHAFT FÜR ENDOSKOPIE UND BILDGEBENDE VERFAHREN E.V. (DGE-BV)
March 28 – 30, 2019 | Stuttgart
- Claire Chalopin | lecture: ‘Supervised Tissue Discrimination during Thyroid and Parathyroid Surgery Based on Hyperspectral Imaging’
- Andreas Melzer | board member; congress opening and welcome; invited lecture: ‘AI und Machine learning im OP der Zukunft’

EU CIVIL PROTECTION EXERCISE (MODEX)
April, 11 – 13, 2019 | Tallin, Estonia
- Christoph Georgi, Erik Schreiber | presentation and evaluation of ICCAS’ electronic patient file under real conditions of a field hospital in a simulated situation after a meteorite impact with accompanying flash flood

KONGRESS FÜR TECHNIK UND HYGIENE IM KRANKENHAUS – WÜMEK
May 8 – 9, 2019 | Würzburg
Thomas Neumuth | lecture: ‘Der intelligente Operationssaal’ in coordination with OR.NET e.V.

2. GEMEINSAME JAHRESTAGUNG DER MITTELDEUTSCHEN GESELLSCHAFT FÜR GASTROENTEROLOGIE (MGG) UND DER MITTELDEUTSCHEN CHIRURGENVEREINIGUNG (MDCV)
May 10 – 11, 2019 | Halle/Saale
- Hannes Köhler | lecture: ‘Hyperspectral Imaging (HSI) during Esophagectomy for the Measurement of Ischemic Conditioning Effects of the Gastric Conduit’
- Marianne Maktabi | poster: ‘Automatic tissue classification based on hyperspectral imaging’

DGAV OP-WORKSHOP ‘HSI IN DER VISZERALCHIRURGIE’
May 17, 2019 | University of Viszeral, Transplantation, Thoracic and Vascular Surgery, University Hospital Leipzig
- Hannes Köhler | lecture: ‘Hyperspektro-Imaging (HSI): Technische Aspekte ‘in a nutshell’
- Marianne Maktabi | lecture: ‘Gewebeklassifikation und Tumordetektion mittels HSI’
- Claire Chalopin, Thomas Neumuth | management

TREFF DER WISSENSCHAFTLERN IM SIKT
May 21, 2019 | Saxony Incubator for Clinical Translation (SIKT), Leipzig
- Lisa Landgraf | lecture: ‘Bildgestützter fokussierter Ultraschall: Technische Grundlagen und Einsatz in der Krebstherapie’

42ND CANADIAN MEDICAL AND BIOLOGICAL ENGINEERING CONFERENCE (CMBEC42)
May 21 – 24, 2019 | Ottawa, Canada
- Max Rockstroh | lecture: ‘SDC – A new Interoperability Standard for Electromedical Devices – IEEE 11073’ in cooperation with OR.NET e.V.

INTERNATIONAL CONFERENCE ON ROBOTICS AND AUTOMATION (ICRA)
May 20 – 24, 2019 | Montréal, Canada
- Max Rockstroh | lecture: ‘The IEEE11073 SDC - Standard Family: Networked Medical Devices in Operating Room and Clinic’

FIELD HOSPITAL EXERCISE
May 21 – 23, 2019 | Gurcy-le-Châtel, France
- Jan Gaebel, Erik Schreiber | establishment of an European Modular Field Hospital (EU-MFH) training network in an simulated scenario of a nerve gas attack in cooperation with army, emergency services and police

33RD ANNUAL MEETING OF THE EUROPEAN SOCIETY FOR HYPERTHERMIC ONCOLOGY (ESHO)
May 22 – 24, 2019 | Warsaw, Poland
- Xinrui Zhang | lecture: ‘Focused Ultrasound-Induced Hyperthermia as Radiosensitizer for Glioblastoma, Prostate Cancer and Head and Neck Cancer Cell Lines’

100. DEUTSCHER RÖNTGENKONGRESS
May 29 – June 1, 2019 | Leipzig

27TH INTERNATIONAL CONGRESS OF THE EUROPEAN ASSOCIATION FOR ENDOSCOPIC SURGERY (EAES)
June 12 – 14, 2019 | Seville, Spain
- Johann Berger | lecture: ‘Modelling a Collaborative Robot with the IEEE 11073 SDC Standard for Combined Focused Ultrasound and Radiation Therapy’
- Andreas Melzer | invited Sir Alfred Cuschieri technology lecture: ‘Image Guided Surgery’; course director: ‘Ultrasound’

33RD INTERNATIONAL CONFERENCE ON COMPUTER ASSISTED RADIOLOGY AND SURGERY (CARS)
June 18 – 21, 2019 | Rennes, France
- Johann Berger | lecture: ‘GATOR: Connecting Integrated Operating Room Solutions Based on the IEEE 11073 SDC and ORIN Standards’
- Marianne Maktabi | lecture: ‘Tissue Classification of Esophagus Resected Tissue Based on Hyperspectral Data’
• Andreas Melzer | program committee
• Juliane Neumann | lecture: ‘Extending BPMN 2.0 for Intraoperative Workflow Modeling with IEEE 11073 SDC for Description and Orchestration of Interoperable, Networked Medical Devices’
• Thomas Neumuth | invited lecture: ‘OR.NET and beyond: AI and machine learning in the OR of the Future’

12TH HAMLYN SYMPOSIUM ON MEDICAL ROBOTICS ON ‘CLINICAL CHALLENGES AND LEVELS OF AUTONOMY’
June 23 – 26, 2019 | London, UK
• Andreas Melzer | lecture: ‘New Technologies for MR guided Endovascular Procedures: Cardiac Biopsy, Aortic Coarctation Stenting, Heart Valve Prosthesis and Thrombolysis’

ANNUAL MEETING OF THE CARDIOVASCULAR AND INTERVENTIONAL RADIOLOGICAL SOCIETY OF EUROPE (CIRSE)
September 7 – 10, 2019 | Barcelona, Spain
• Upasana Roy | lecture: ‘Platform for Preclinical MRI-Guided Focused Ultrasound Hyperthermia’

63. ÖSTERREICHISCHER HNO-KONGRESS
September 11 – 14, 2019 | Salzburg, Austria
• Andreas Dietz | lecture: ‘Operationssaal der Zukunft’

HEALTHCARE HACKATHON KIEL
September 12 – 13, 2019 | Kiel
• Max Rockstroh | topic developing and presentation to public and media

JAHRESSYMPOSIUM DER DEUTSCHEN NOTES ARBEITSGRUPPE (D-NOTES)
September 13, 2019 | Hannover
• Andreas Neumuth | lecture: ‘Surgical Workflows’

EUROPEAN SPACE AGENCY (ESA) - MEETING
September 17 – 18, 2019 | Bologna, Italy
• Andreas Melzer | lecture: ‘Anwendung FUS/HIFU auf der Marsmission’

18. JAHRESTAGUNG DER DEUTSCHEN GESELLSCHAFT FÜR COMPUTER- UND ROBOTER-ASSISTIERTE CHIRURGIE (CURAC)
September 19 – 21, 2019 | Reutlingen
• Stefan Franke | lecture: ‘Design of a Dynamic User Interface for IEEE 11073 SDC Interoperability Testing’
• Hannes Köhler | lecture: ‘Hyperspektralbildgebung (HSI) für die intraoperative ortsaufgelöste Quantifizierung des Fettgehalts von Gewebe’
• Patrick Kogtsos | lecture: ‘Konzept eines anatomischen Atlas für medizinische Studien und patientenspezifische 3D-Modelle’
• Juliane Neumann | lecture: ‘Ergonomic Assessment of Operating Room Setups for Orthopedic Reconstructive Surgery’

64TH INTERNATIONAL CONGRESS OF HEARING AID ACOUSTICIANS (EUHA)
October 16 – 18, 2019 | Nuremberg
• Andreas Dietz | lecture: ‘Artificial Intelligence in the Operating Theatre of the Future’

2ND ANNUAL CONGRESS OF THE EUROPEAN ASSOCIATION OF NUCLEAR MEDICINE (EANM)
October 12 – 16, 2019 | Barcelona, Spain
• Andreas Melzer | lecture: ‘Nuclear Medicine Guided Focused Ultrasound – A Potential Future Application’

43. DREILÄNDERTREFFEN DER DGUM, ÖGUM, SGUM
October 16 – 19, 2019 | Leipzig
• Lisa Landgraf | lecture: ‘Klinische Anwendungen der MR-gestützten Ultraschalltherapie’

DIGITAL-GIPPEL 2019
October 28 – 29, 2019 | Dortmund
• Thomas Neumuth | panel discussion: ‘Forschung – KI für digitale Plattformen’

23. SYMPOSIUM TECHNISCHE TEXTILIEN
November 13, 2019 | Reichenbach
• Julia Mrongowius | lecture: ‘Patientenüberwachung mittels textiler Sensorik in der Notfallmedizin’

INTERNATIONAL CONFERENCE ON BIOMEDICAL TECHNOLOGY (ICBT)
November 18 – 20, 2019 | Hannover
• Andreas Melzer | plenary lecture: ‘Advanced Technologies for Image Guided Interventions’

10TH NATIONAL CONGRESS OF THE ROMANIAN ASSOCIATION FOR ENDOSCOPIC SURGERY (ARCE)
11TH NATIONAL SYMPOSIUM OF BARIATRIC AND METABOLIC SURGERY
November 21 – 23, 2019 | Bucharest, Romania

SCADS.AI KICK-OFF-EVENT
November 27, 2019 | Leipzig
• Thomas Neumuth | lecture: ‘Medical Image and Data Analyses’

105TH SCIENTIFIC ASSEMBLY AND ANNUAL MEETING OF THE RADIOLOGICAL SOCIETY OF NORTH AMERICA (RSNA)
November 30 – December 4, 2019 | Chicago, IL, USA
• Andreas Melzer | lecture: ‘Radiosensitization of Human Cancer Cells In Vitro with Focused Ultrasound Induced Hyperthermia’

PRESENTATIONS AT FAIRS
DIGITAL MEDICAL EXPERTISE & APPLICATIONS (DMEA)
April 9 – 11, 2019 | Berlin
• Stefan Franke, Christoph Georgi, Thomas Neumuth, Max Rockstroh | showcase for the Service-Oriented Device Connectivity (SDC) - Standard in cooperation with OR.NET e.V.

INNOVATIONSTAG MITTELSTAND DES BUNDESMINISTERIUMS FÜR WIRTSCHAFT UND ENERGIE (BMWI)
May 9, 2019 | Berlin
• Claire Chlopin, Hannes Köhler | booth presentation: ‘Hyperspektralbildgebungssystem zur nichtinvasiven Messung der Hautdurchblutung und Oberflächenfeuchtigkeit zur Beurteilung des Patientenzustandes’

19TH SYMPOSIUM OF THE INTERNATIONAL SOCIETY FOR THERAPEUTIC ULTRASOUND (ISTU)
STH SYMPOSIUM OF THE EUROPEAN FOCUSED ULTRASOUND CHARITABLE SOCIETY (EU-FUS)
June 13 – 15, 2019 | Barcelona, Spain
• SONO-RAV-group | exhibition booth
• Johann Berger | posters: ‘Modelling a Collaborative Robot with the IEEE 11073 SDC Standard for Combined Focused Ultrasound and Radiation Therapy’, ‘Evaluation of a Mobile Ultrasound Device for Robot Assisted Focused Ultrasound Applications’
• Lisa Landgraf | invited session chair: ‘Therapy Ultrasound plus’
• Andreas Melzer | congress co-chair; EUFUS organizing committee; welcome and closing; invited session chairs: ‘Organ Panel: Prostate and Kidney’, ‘Other Clinical Vascular and Benign HIFU Applications’; invited lecture: ‘TRANS-FUSIMO – Model Based Treatment Support for FUS in Moving Abdominal Organs’, poster: ‘Robotic Driven Motion Model for Static vs Dynamic MRgFUS Systems’
• Upasana Roy | poster: ‘Preclinical MRI-Guided Focused Ultrasound Hyperthermia in 7 Tesla MRI’
• Xinrui Zhang | poster: ‘In Vitro Focused Ultrasound Hyperthermia for Radiosensitization of Human Cancer Cells’

53RD ANNUAL CONFERENCE OF THE GERMAN SOCIETY FOR BIOMEDICAL ENGINEERING (DGBMT WITHIN VDE) (BMT)
September 25 – 26, 2019 | Frankfurt/Main
• Johann Berger | lecture: ‘IEEE 11073 Compliant SDC Modelling of a Collaborative Robot for the Application of Focused Ultrasound in Radiation Therapy’
• Richard Bieck | lecture: ‘Surface EMG-Based Surgical Instrument Classification for Dynamic Activity Recognition in Surgical Workflows’
• Jesús Guillermo Cabal Aragón | poster: ‘The AutoSon Project: Improvement of a Neuronavigation System for Neurosurgical Procedures’
• Stefan Franke | lecture: ‘Models for Personalized Cancer Treatment’
• Reinhard Fuchs | lecture: ‘Electrical Impedance Tomography for Monitoring of Homogeneous Pulmonary Ventilation’
• Andreas Melzer | chair: ‘Artificial Intelligence’, ‘Personalized Medicine’; technical committee pitch: ‘Medizintechnik in der MRT’
• Thomas Neumuth | technical committee pitch and lecture: ‘Modellgestützte personalisierte Medizintechnik’
• Alexander Oeser | lecture: ‘Development of an Assistance System for the Intuitive Assessment of Laboratory Findings in Oncology’
• Upasana Roy | poster: ‘Preclinical MRI-Guided Focused Ultrasound Hyperthermia in 7 Tesla MRI’
• Michael Unger | poster: ‘Vision-Based Depth Measurement for Laparoscopic Hyperspectral Imaging’
• Michael Unger, Xinrui Zhang | lecture: ‘In vitro Radiosensitization of Human Cancer Cells with Focused Ultrasound Induced Hyperthermia’

31ST CONFERENCE OF THE INTERNATIONAL SOCIETY FOR MEDICAL INNOVATION AND TECHNOLOGY (SMIT)
October 10 – 13, 2019 | Heilbronn
• Johann Berger | lecture: ‘Augmented Reality-Based Treatment Planning for Robotic Positioning in Image-Guided Interventions’; science slam contribution: ‘Science Fiction in the OR – How Robert Learned to Fight Cancer’
• Lisa Landgraf, C. Martin Reich | science slam contribution: ‘The Sexiness of MRI Guided Interventions’
• Andreas Melzer | session moderations: ‘Operating Room of the Future’, ‘closure’; lecture: ‘State of the Art and Future Developments of OR Technology’
• Thomas Neumuth | lecture: ‘Value-Added Services Based on SDC’
• Annekatrin Pfahl | lecture: ‘Visualization of Instruments for Minimally Invasive MR-Guided Interventions’
• Upasana Roy | lecture: ‘Towards Magnetic Resonance Image-Guided Focused Ultrasound in Vivo in 7 Tesla Preclinical MRI’
• Xinrui Zhang | poster: ‘Focused Ultrasound Radiosensitize Prostate Cancer Cells in Vitro’

MEDICA 2019
November 18 – 21, 2019 | Düsseldorf
• Thomas Neumuth | lecture: ‘OR.NET e.V. – Gerätevernetzung in OP und Klinik 4.0 wird Standard’
• Stefan Franke, Max Rockstroh | booth presentation on Device Networking and ICCAS’ ‘Intelligent OR’

PROJECT- AND COOPERATION WORK

2ND SONO-RAY STATUS SEMINAR
January 25, 2019 | OncoRay, Dresden
• SONO-RAY-group | Presentation of SONO-RAY’s research results

KICK-OFF MR-STENTS AND MR-THROMBOSIS-THERANOSTIC
April 1 – 2, 2019 | EPflex, Dettingen/Erms
• Andreas Melzer, Andreas Seifert | meeting of project partners and project aims declaration

KICK-OFF MOMENTUM
November 7, 2019 | ICCAS
MOMENTUM-group | meeting of project partners and project aims declaration

KICK-OFF SANO’S SCIENTIFIC COMMITTEE
November 25 – 27, 2019 | Sano – Centre for Computational Personalized Medicine, Krakow, Poland
• Claire Chalopin | member: board; lecture on research and clinic transfer

HYPERSONTICAL IMAGING (HSI) - WORKSHOP
December 4, 2019 | ICCAS
• Claire Chalopin, Hannes Köhler, Marianne Maktabi | Clarification of technical issues in cooperation with Diaspective Vision GmbH, Firma KARL STORZ SE & Co. KG and the German Cancer Research Center (DKFZ)

FINAL PRESENTATION OF THE MOVE PROJECT
December 11, 2019 | Leipzig
• MoVE-group | final presentation of the research project MoVE in the KMU-NetC funding program

#UNIVERSITY COURSES

LEIPZIG UNIVERSITY
Computer Assisted Surgery
Faculty of Mathematics and Computer Science
practical course

Development of Medical Products
Faculty of Mathematics and Computer Science
lecture

Introduction to Computer Assisted Surgery
Faculty of Medicine
lecture

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

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

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

LEIPZIG UNIVERSITY OF APPLIED SCIENCES (HTWK)
Developing Medical Products
Faculty of Electrical Engineering and Information Technology
lecture and seminar

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

System Engineering
Faculty of Electrical Engineering and Information Technology
lecture
HABILITATION DEGREE
Claire Chalopin
‘Extended non-standard intraoperative imaging in head surgery: Contrast-enhanced ultrasound imaging and infrared thermography’ - Leipzig University

DOCOTRAL DEGREE
PAUL RATHMANN
‘Dynamische Infrarot-Thermographie (DIRT) zur Darstellung der Hautdurchblutung bei Kranioplastie-Eingriffen: eine Machbarkeitsstudie zum qualitativen Vergleich mit dem Standard Indocyanin-Grün Video Angiographie (ICGA)’ - Leipzig University

MASTER DEGREES
Margarita Ivanova
‘Classification of Hyperspectral Endocrine Tissue Images Using Supervised Machine Learning’ - Methods’ University of Glasgow (GB)
David Lepach
‘Entwicklung einer Methodik zur Prädiktion und Simulation von Diagnose- und Patientenaufkommen in Feldhospitälern’ - Leipzig University of Applied Sciences (HTWK)
Tim Meschke
‘Automatische Situationserkennung und -vorschätzung bei Bandscheibenerkrankungen durch Surgical Intervention Ontology’ - Leipzig University
Erick Angel Raya
‘Brain Tumor Segmentation on 3D Intraoperative Ultrasound Images (3D-iUS)’ - University of Guanajuato (MEX)
Gergely Pogany
‘Development of an approach for the automatic classification of the skin blood vessels in medical dynamic infrared thermography (DIRT)’ - University of Glasgow (GB)

BACHELOR DEGREE
Johanna Fleck
‘Entwicklung eines digitalen 3D-Herzmodells auf der Grundlage des Visible Human Male Datensatzes als Erweiterung für ein bestehendes Gefäßmodell’ - University of Applied Sciences Zwickau

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