International Workshop on Medical Ultrasound Tomography

1.– 3. Nov. 2017, Speyer, Germany

PROGRAM

Welcome

Dear colleagues,

It is a great pleasure for us to welcome you all in Speyer for the first International Workshop on Medical Ultrasound Tomography (MUST).

Ultrasound Tomography is an emerging technology for medical imaging that is quickly approaching its clinical utility. Multiple research groups around the globe are engaged in research spanning from theory to practical clinical applications and commercialization. The MUST workshop aims in bringing together scientists from all over the world to exchange their knowledge and discuss new ideas and research results in order to boost the research in Ultrasound Tomography and related fields.

We are very excited to host this workshop and would like to sincerely thank all the colleagues involved in the scientific and local committee for their commitment. We are furthermore grateful for the support by Deutsche Forschungsgemeinschaft (DFG), the city of Speyer and Pepperl + Fuchs GmbH.

We are looking forward to the exciting upcoming days.

Welcome and enjoy the workshop!
N. Ruiter & T. Hopp

Scientific committee

Jeffrey C. Bamber
Institute of Cancer Research, UK

Koen W. A. van Dongen
Technical University Delft, Netherlands

Neb Duric
Delphinus Medical Technologies, US

Torsten Hopp
Karlsruhe Institute of Technology, Germany

Nicole V. Ruiter
Karlsruhe Institute of Technology, Germany

Local committee

Karlsruhe Institute of Technology, Germany

Torsten Hopp
Nicole V. Ruiter
Saskia Baier
Christiane Buchwald
Antje Martin

DFG Deutsche Forschungsgemeinschaft

Financial support by DFG under grant
HO 5565/2-1, HE 3011/37-1

Practical information

Language
English is the official language of the workshop.

Registration and information desk
The registration desk is located in the hotel lobby. The registration desk is open

- Tuesday, Oct. 31st: 16:30 – 18:00
- Wednesday, Nov. 1st: 08:00 – 18:00
- Thursday, Nov. 2nd: 08:00 – 18:00
- Friday, Nov. 3rd: 08:00 – 16:00

Should you have any questions do not hesitate to contact us at the registration and information desk or via e-mail: must-workshop@ipe.kit.edu.

Registration fee
The registration fee is 500 EUR (regular) respectively 375 EUR (students). It includes access to all scientific sessions, coffee breaks, lunch, welcome reception and conference dinner.

Certificate of attendance
If you wish to obtain a certificate of attendance, please contact the registration and information desk or send an e-mail to must-workshop@ipe.kit.edu.

Oral presentations
Please upload your presentation slides to the presentation notebook in the lecture hall during the break before your presentation at latest. Oral presentation time slots are 20 minutes including 5 minutes for discussion.

Posters
Posters are located in the back of the lecture hall. Posters are supposed to be displayed during the entire workshop. Please put up your poster until the first coffee break on Wednesday, November 1.

Coffee breaks
Coffee, tea and snacks will be served in the foyer of the lecture hall.

Lunch
Lunch will be served in the restaurant Domhof in room "Domstubb". Enter the restaurant at the front entrance (ground level) and take the stairs on the right to the first floor.
Sparkling water and apple juice are provided free of charge. Additional drinks can only be ordered on cash payment. The restaurant offers a two-course menu with a daily selection of two main dishes, including a vegetarian/vegan main dish.

Internet access at workshop venue
Wi-Fi is available in the lecture hall and in the entire hotel for free. Please connect to the network "Domhof".

Book of abstracts
The book of abstracts is available for download at the workshop web page:
https://indico.scc.kit.edu/indico/e/MUST

Workshop proceedings
Workshop proceedings will be open access and have an ISBN key allowing citation. They will be available online and by print-on-demand two to three months after the workshop.

Venue address
Hotel Domhof
Bauhof 3
67346 Speyer (Germany)

Parking
The parking lot in front of the hotel entrance is free of charge. The parking garage is available at a daily rate of 7.50 EUR.

Public holiday
Please note that Oct. 31st and Nov. 1st are public holidays in Germany. On these days most shops are closed and public transportation may run on reduced schedule.

Taxi

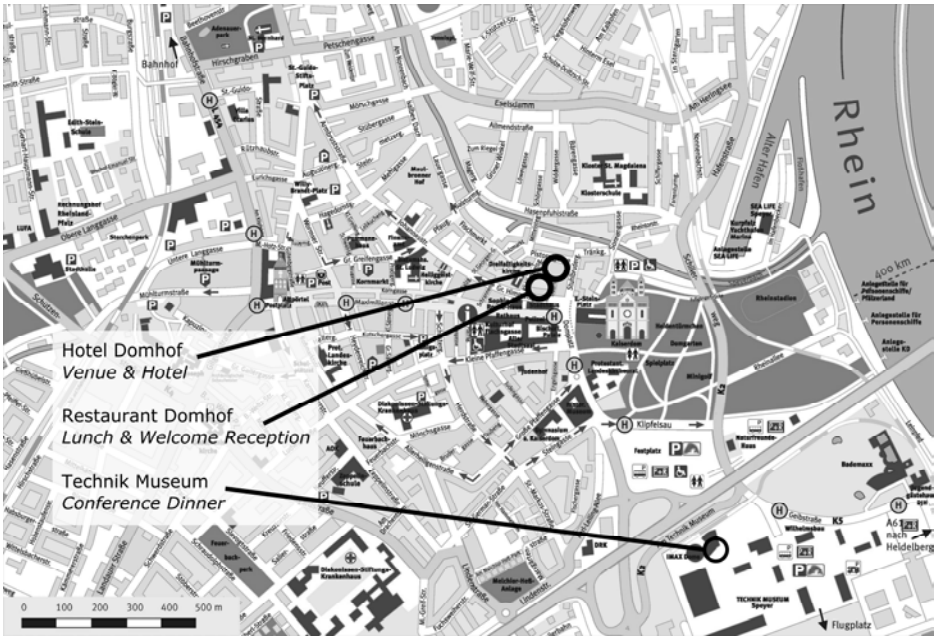
Taxihaus Speyer	+49 6232 34750
Taxi Merl	+49 6232 24117
Taxi Ahmed	+49 6232 290292

ATM
ATMs are located at several banks at the Maximilian street.

Public transportation
For travel within Speyer we recommend taking the public bus. The stop "Dom/Stadthaus" is closest to Hotel Domhof. The city rate (1.10 EUR) applies for travels on bus route 564 and 565 between Speyer main station and the stop "Flugzeugwerke". Tickets can be purchased on the bus. A system map is available at the information desk.

Tickets for local trains and commuter railway system running from Speyer main station are available at the ticket machines at the main station, see https://www.vrn.de/ for details.

Map of important locations



What to see and do in Speyer

Speyer is one of the oldest cities in Germany. The main sights are

- Speyer cathedral
- Maximilian street and the historic center with the old town gate, old mint and city hall
- Memorial church
- Trinity church
- Jewish courtyard
- Technik Museum (transportation museum)
- Historical museum of the palatinate
- Speyer Sea Life

All attractions are within walking distance. A city map and a short description of the main sights is included in your conference bag.

The tourist information is located at Maximilian street 13, close to the city hall and old mint (telephone +49 6232 142392, e-mail: touristinformation@stadt-speyer.de). Opening hours are Mon. - Fri. 09.00 - 17.00, Sat. 10.00 - 12.00.

Social events

Welcome reception
Tuesday, Oct. 31, 17:00 – 18:00, Hotel Domhof, foyer of lecture hall

The welcome reception will be held at the conference venue Hotel Domhof on the evening before the first day of the workshop. We will be happy to welcome our early arriving attendees for a glass of wine or beer and snacks before everybody is free to enjoy a dinner in the restaurant Domhof or in one of the various restaurants nearby.

Note: Pre-registration for attendees and accompanying persons is mandatory.
Dress code: informal.

Conference dinner
Thursday, Nov. 2, 18:00 – 23:00, Technik Museum Speyer

The conference dinner will be held at the Technik Museum Speyer. After the last workshop session of the day we will meet at 18:00 in the lobby of Hotel Domhof for a short walk, which will take us past the cathedral and the cathedral garden.

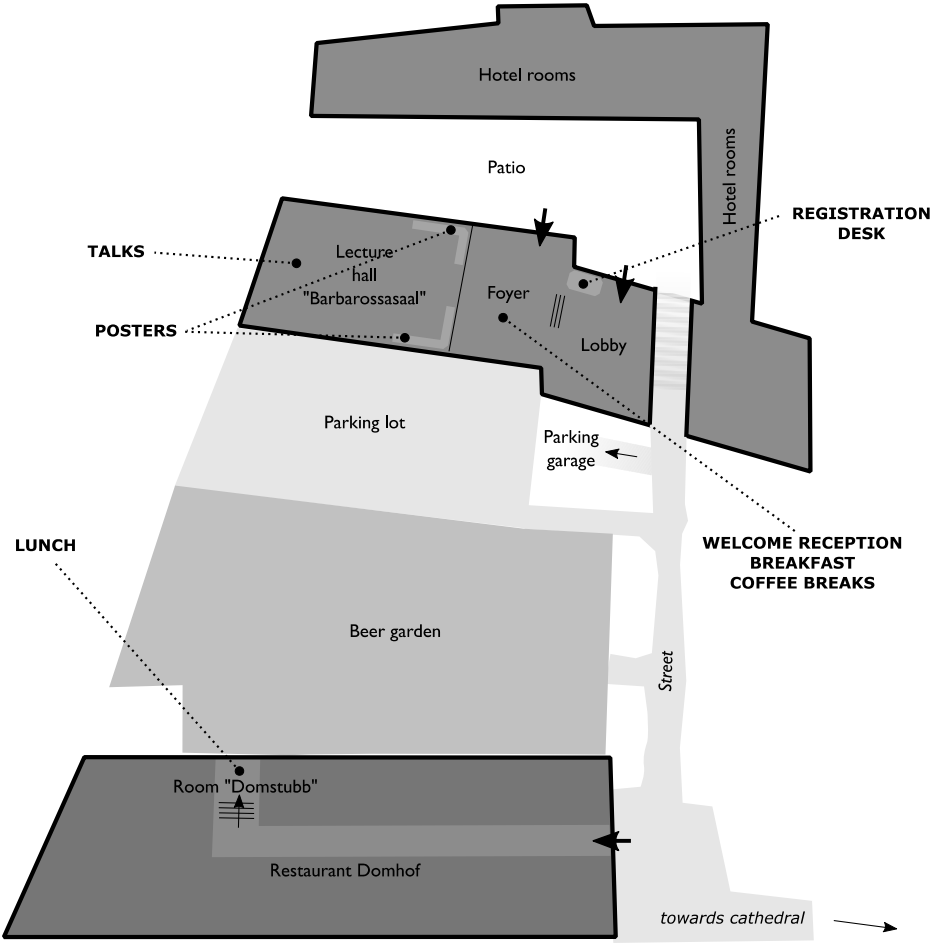
At the Technik Museum we will have a champagne reception at 18:30 before receiving a guided tour through the highlights of the museum. Enjoy visiting an original jumbo jet, inspect the inner workings of a submarine and a sea rescue cruiser. Among others you will find the largest space flight exhibition in Europe, offering the russian space shuttle BURAN, an original moonstone, space suits, a Soyuz landing capsule, as well as historic locomotives, vintage cars, fire trucks, motorcycles, and thousands of other exhibits.

After our museum tour the conference dinner will be served in the museum owned event location "palatinate wine village".

Note: Pre-registration for attendees and accompanying persons is mandatory. If you do not join the short walk to the museum, please make sure to be at the Technik Museum on time at 18:30. Parking is free of charge upon request.

Dress code: informal. Note that the guided tour includes a visit to the open-air exhibition ground. A cloakroom is available at the dinner location.

Venue map


Hotel rooms
Patio
Hotel rooms
REGISTRATION DESK
TALKS
Lecture hall "Barbarossasaal"
POSTERS
Foyer
Lobby
Parking lot
Parking garage
LUNCH
WELCOME RECEPTION
BREAKFAST
COFFEE BREAKS
Beer garden
Street
Room "Domstubb"
Restaurant Domhof
towards cathedral

Invited talks

Current challenges in breast screening and diagnosis

Peter J. Littrup, *Crittenton Hospital Rochester, Delphinus Medical Technologies, USA*
Wednesday Nov 1st, 8:50

ABSTRACT ▪ Breast cancer screening and diagnosis can save lives through early detection and curative treatments. Continued controversy and publicity arises when potentially life-saving technologies are balanced against epidemiologic and cost-efficacy concerns. Both 2D digital mammography and tomosynthesis (3D) have already established their utility over plain film, while 3D has shown greater cancer detection while reducing unnecessary call-backs. Improved sensitivity and specificity lead to better test performance and potential cost-efficacy. Current breast ultrasound screening efforts for women with dense breasts have improved cancer detection but still suffer from greater total callbacks and lack of color Doppler and/or elastography to potentially improve specificity. A roadmap thus exists for breast ultrasound tomography to overcome the obstacles necessary to produce a paradigm shift in breast imaging.

Medical ultrasound tomography: lessons from exploration geophysics

R. Gerhard Pratt, *University of Western Ontario, Canada*
Wednesday Nov 1st, 13:20

ABSTRACT ▪ The seismic method is a widely-used imaging tool in the geophysical exploration industry. This has led to the development of powerful imaging methods, in some cases inspired by and akin to those used in medical ultrasound tomography. In both exploration seismology` and in medical imaging, the experiment involves the propagation of sound waves over distances of a few tens of wavelengths to a few hundred wavelengths. In both cases the transmitters and receiver design is used to control bandwidth and illumination apertures. However, in exploration seismology i) access to the target is unusually restricted, ii) geological targets are often embedded in strongly scattering material, iii) we cannot ignore 3D heterogeneity, elastic wave effects including mode conversions, and anisotropic wave propagation, and iv) we must account for the presence of high amplitude dispersive modes associated with the free surface of the Earth.
In exploration the past decade has seen the emergence of "Full Waveform Inversion" (FWI) as a remarkably successful innovation. Historically, seismic imaging methods have been most successful when applied to back-scattered (aka reflected) waves. FWI, in contrast, has to date been most successful with transmitted (aka refracted) waves. FWI of reflected data is progressing, but significant problems remain. These include i) handling the significant non-linearity and non-uniquenesses that are inherent in the experiment, and ii) convincing skilled interpreters that FWI yields a new type of image that contributes in significant (but unusual) ways. It is suggested that the field of medical ultrasound tomography shares these problems and that there is much to be learned by cross-fertilization in both fields.

Multiscale full-waveform inversion: From the whole earth to the human breast

Andreas Fichtner, *Swiss Federal Institute of Technology (ETH) Zurich, Switzerland*
Wednesday Nov 1st, 15:00

ABSTRACT ▪ Seismic tomography using earthquake or explosion data is among the most powerful tools to explore the internal structure of the Earth. The images that it produces are used to study the evolution of our planet, locate and monitor natural resources, constrain the mechanisms of large earthquakes, issue earthquake and tsunami early warnings, and to monitor the Nuclear Test Ban Treaty. In recent years, seismic tomography has been experiencing a shift from classical ray-based methods to full-waveform inversion, built on the combination of numerical wavefield simulations and adjoint techniques. As a result, more of the

available waveform data can be exploited, and the resolution of Earth models is increased. The simultaneous emergence of full-waveform inversion in different fields - ranging from whole-Earth tomography to medical imaging - offers new opportunities for interdisciplinary collaboration. In this spirit, I will review recent developments and applications in seismic full-waveform inversion, emphasizing similarities and differences with respect to medical imaging problems. This is intended to serve as the starting point for further discussions that may help to bridge the (language) gap between the medical and seismological communities.

Ultrasound Computed Tomography: Historically Guided Musings

James F. Greenleaf, *Mayo Clinic, USA*
Thursday Nov 2nd, 8:50

ABSTRACT ▪ Computed Tomography with ultrasound waves, in both through transmission and reflection, has been investigated for over 40 years. In that time investigators have concentrated on the complex interactions of ultrasonic waves with the tissue of the human female breast in an effort to delineate malignant from benign lesions. Over the years the relentless improvement of both electronics and computer power has allowed the inverse solution of more and more complex mathematical models of wave propagation through complex tissue such as the breast. However, the need for complete three-dimensional acquisition of scattering waves from the tissue continues to be a difficult technological problem. In addition to the technical challenges are the challenges of finding where in the flow diagram of breast disease patients traversing the health care system to place ultrasound breast tomography to provide the most effective contribution to the efficacy and efficiency of breast disease detection, diagnosis, and treatment. Meanwhile, other modalities are developing that provide very stiff competition to the field of computed ultrasound tomography of the breast. Historical examples and current implementations will be described and discussed.

Latest developments in ultrasound transducer technology and future directions

Nicolaas de Jong, *Technical University of Delft, Netherlands*
Thursday Nov 2nd, 13:20

ABSTRACT ▪ Standard clinical diagnostic ultrasound systems are making cross-sectional (2D planes) views with a linear array transducer consisting of about 100-200 elements. For advanced diagnosis real-time three-dimensional imaging with adequate spatial and high temporal resolution is needed. Three major directions are currently under development: Firstly, the ultrasound systems having matrix array transducers with 10,000+ elements together with embedded electronics (Application Specific Integrated Circuits (ASICs)). Secondly, high frame rate imaging with (volume) frame rates of 100 – 2000 frames per second. Thirdly, the processing of the huge amount of data as received by the individual elements for generating (parametric) images in real-time.

The research focusses on medical acoustical imaging of the heart, liver, kidney, brain, breast and other organs. It includes new ways of measuring the perfusion of the myocardium, developing new accurate three dimensional imaging methods and therapeutic applications. The research lines are the bubble physics for (molecular) imaging and drug delivery, development of matrix transducers with integrated electronics for three dimensional imaging (e.g. catheter based three dimensional ultrasound imaging) and imaging methods like superharmonic imaging and shear wave imaging. It also includes flow patterns determination in the left ventricle and development of ultrasound methods for stiffness determination of the septal wall of the left ventricle for heart failure patients, construction of very small ultrasound transducers with integrated electronics for use in small children and baby's and devices for 3D imaging of the carotid artery for vulnerable plaque determination.

Challenges of breast ultrasound

Helmut Madjar, *DKD HELIOS Klinik Wiesbaden, Germany*
Friday Nov 3rd, 8:50

ABSTRACT ▪ Mammographic screening is used since almost 50 years in menopausal women. However 30% of breast cancers occur in premenopausal women and 30% of menopausal women have dense breasts where mammography fails in up to 50%. Furthermore women with dense breasts have higher risk to develop breast cancer. Diagnostic studies using high quality ultrasound technology (US) have proven a 30-40% increased detection rate of small cancers in young women and women with dense breasts. The problem is that US is operator dependent and requires a systematic examination to cover the whole breast. Reproducibility is problematic with hand-held US. ABUS technology was developed to overcome these problems but requires a number of scan procedures to cover the entire breast, it depends on operator skills and the static scans do not allow to measure vascularity or elastography. A systematic and fast technology which performs whole breast scans in high quality allowing to measure reflectivity as well as other tissue properties could overcome these problems. However, large studies are required to prove its accuracy.

Optoacoustic tomography and the pathway to commercialization

Christian Wiest, *iThera Medical GmbH, Germany*
Friday Nov 3rd, 13:20

ABSTRACT ▪ Optoacoustic tomography (OAT) is a novel imaging technology that has seen rapid adoption by the biomedical scientific community in the last few years. OAT utilizes the photoacoustic effect to visualize and quantify anatomical, functional and molecular information, in vivo, in deep tissue and in real time. It allows the preclinical study of disease processes on a molecular level as well as the non-invasive analysis of pharmacokinetic and biodistribution properties for new substances. Recently, OAT has been translated for clinical use. Initial patient studies have been conducted in the areas of skin cancer, breast cancer, inflammatory bowel disease, and vascular diseases. While the results of these early clinical trials are very promising, the commercial success of the technology will depend on establishing OAT as a diagnostic standard for particular applications and the ability for health care providers to realize sustainable reimbursement for such OAT procedures.

Potential impact of ultrasound tomography in the clinic

Peter J. Littrup, *Crittenton Hospital Rochester, Delphinus Medical Technologies, USA*
Friday Nov 3rd, 17:00

ABSTRACT ▪ During this conference, many facets of breast ultrasound tomography (UST) have been presented. Focus was made upon the technical specifications needed for many applications of UST, especially for screening in women with dense breasts and improved clinical diagnosis. Improved cancer detection while limiting call-backs and reducing unnecessary biopsies are now possible. Normal, benign and malignant breast tissue characterization is possible from quantitative analyses of multi-parameter UST radiomics. Breast density can be accurately estimated without ionizing radiation or expensive MR, as well as monitoring density modification for chemoprevention. As UST becomes a crucial part in the emerging standard of care, greater use of IV contrast, biopsy and treatment guidance/monitoring is expected.

Program

Tuesday, Oct 31st	
17:00-18:00	Welcome Reception *Venue: Foyer of lecture hall* *See section social events for details*

Wednesday, Nov 1st	
08:30	Opening ceremony Speaker: *J. Bamber (The Institute of Cancer Research)* Chairs: *N. Ruiter, T. Hopp (Karlsruhe Institute of Technology)*
08:50	**Invited talk:** Current challenges in breast screening and diagnosis *P. Littrup (Crittenton Hospital Rochester, Delphinus Medical Technologies)*

Session 1: Imaging and inversion I Chairs: *A. Fichtner (ETH Zurich), J. Hesser (Heidelberg University)*	
09:30	One-dimensional Marchenko inversion in stretched space *J. van der Neut, J. Fokkema, P. van den Berg (Delft University of Technology)*
09:50	Ultrasound imaging from reflection data. *F. Natterer (University of Münster)*
10:10	Using 2-D approximation of the 3-D incident field for Born inversion *U. Taskin, L. Heijnsdijk, L. Hoogerbrugge, K. van Dongen (Delft University of Technology)*

10:30	Coffee break

Session 2: Imaging and inversion II Chairs: *F. Natterer (University of Münster), J. van der Neut (Delft University of Technology)*	
11:00	USCT Image Reconstruction: Acceleration using Gauss-Newton Preconditioned Conjugate Gradient *H. Wang (Heidelberg University), H. Gemmeke, T. Hopp (Karlsruhe Institute of Technology), J. Hesser (Heidelberg University)*
11:20	3D time-domain spectral-element ultrasound waveform tomography *C. Boehm, N. Korta Martiartu (ETH Zurich), I. Jovanovic Balic (SonoView Acoustic Sensing Technologies), A. Fichtner (ETH Zurich)*
11:40	Joint reconstruction of the initial pressure and sound speed distributions from combined photoacoustic and ultrasound tomography measurements *M. Anastasio, T. Matthews (Washington University in St. Louis)*

12:00	Lunch

Session 3: Imaging and inversion III Chairs: *N. Duric (Delphinus Medical Technologies), P. Huthwaite (Imperial College London)*	
13:20	**Invited talk:** Medical ultrasound tomography: lessons from exploration geophysics *G. Pratt (University of Western Ontario)*
14:00	Non-linear Ultrasonic Computed Tomography (USCT) for soft and hard tissue imaging *P. Lasaygues, J. Rouyer, S. Mensah, E. Franceschini, G. Rabau, R. Guillermin, S. Bernard, V. Monteiller, D. Komatitsch (Aix Marseille University, CNRS, Centrale Marseille, Laboratory of Mechanics and Acoustics, Marseille)*
14:20	Scattering Computed Tomography visualizing density distributions by back-propagation *D. Kondo, T. Azuma (The University of Tokyo)*

14:40	Coffee break

Session 4: Imaging and inversion IV Chairs: *K. van Dongen (Delft University of Technology), M. Anastasio (Washington University in St. Louis)*	
15:00	**Invited talk:** Multiscale full-waveform inversion: From the whole earth to the human breast *A. Fichtner (ETH Zurich)*
15:40	Real-Time Ultrasound Transmission Tomography based on Bézier Curves *M. Perez-Liva, J. Udias (University Complutense of Madrid), J. Camacho (Spanish National Research Council), E. Merčep (iThera Medical GmbH), J. Herraiz (University Complutense of Madrid)*
16:00	High resolution breast ultrasound tomography with HARBUT *P. Huthwaite (Imperial College London)*
16:20	3D imaging of the breast using full-waveform inversion *O. Calderon Agudo, L. Guasch, P. Huthwaite, M. Warner (Imperial College London)*

Discussion session Chair: *K. van Dongen (Delft University of Technology)*	
16:40-18:00	Discussion session on imaging and inversion.

Thursday, Nov 2nd

Session 5: Ultrasound tomography systems Chairs: *J. Bamber (The Institute of Cancer Research), T. Azuma (The University of Tokyo)*	
08:50	**Invited talk:** Ultrasound Computed Tomography: Historically Guided Musings *J. Greenleaf (Mayo Clinic)*
09:30	A Multi-Modal Ultrasound Breast Imaging System *J. Camacho, J.F. Cruza, N. Gonzalez-Salido, C. Fritsch (Spanish National Research Council), M. Perez-Liva, J. Herraiz, J. Udas (Universidad Computense de Madrid),*
09:50	First steps towards the Delft Breast Ultrasound Scanning System (DBUS) *L. Heijnsdijk, E. Jansen, H. den Bok, E. Bergsma, E. Noothout, N. de Jong, K. van Dongen (Delft University of Technology)*
10:10	Hybrid Optoacoustic and Ultrasound Imaging System with a Multi-Segment Detector Array *E. Merčep (iThera Medical GmbH), X. Den-Ben (Helmholtz Center Munich), D. Razansky (Technical University of Munich)*

10:30	Coffee break

Session 6: System design Chairs: *I. Jovanovic Balic (SonoView Acoustic Sensing Technologies), T. Hopp (Karlsruhe Institute of Technology)*	
11:00	Source selection for ultrasound waveform tomography: real data case from USCT Data Challenge 2017 *N. Korta Martiartu, C. Boehm, V. Nicolas (ETH Zurich), I. Jovanovic Balic (Sonoview Acoustic Sensing Technologies), A. Fichtner (ETH Zurich)*
11:20	Upper Bound of Accuracy for Self-Calibration of a 3D Ultrasound Tomography System without Ground Truth *W. Tan (Karlsruhe Institute of Technology), T. Steiner (Pepperl+Fuchs GmbH), N. Ruiter (Karlsruhe Institute of Technology)*
11:40	System Design of a Flexible 512-Channel Platform for Ultrasound Computer Tomography *J. Song, Q. Zang, L. Zhou, Y. Peng, Q. Zhou, M. Ding, M. Yuchi (Huazhong University of Science and Technology)*

12:00	Lunch

Session 7: Ultrasound transducers Chairs: *H. Gemmeke (Karlsruhe Institute of Technology), P. Lasaygues (Aix Marseille University)*	
13:20	**Invited talk:** Latest developments in ultrasound transducer technology and future directions *N. de Jong (Delft University of Technology)*
14:00	Technologies for Piezoceramic Composites used for Ultrasonic Transducers *K. Hohlfeld, S. Gebhardt, H. Neubert (Fraunhofer IKTS Dreden)*
14:20	Dice-and-fill single element octagon transducers for next generation 3D USCT *M. Zapf, B. Leyrer, P. Pfistner, C. Liberman (Karlsruhe Institute of Technology), K. van Dongen, N. de Jong (Delft University of Technology), H. Gemmeke, N. Ruiter (Karlsruhe Institute of Technology)*

14:40	Coffee break

Poster session	
15:00-16:00	*See section "Posters" on page 18*

Discussion session Chair: *N. Ruiter (Karlsruhe Institute of Technology)*	
16:00-17:30	Discussion session on systems

Conference dinner	
18:00	Meeting for leaving to the conference dinner venue at the hotel lobby *Short walk of approx. 15 min. to the Technik Museum Speyer*
18:30-23:00	Conference dinner *Venue: Technik Museum Speyer* *See section social events for details* *18:30 Reception at Foyer* *19:00 Guided tour through the highlights of the museum* *20:30 Dinner at the museum restaurant "palatinate wine village"*

Friday, Nov 3rd

Session 8: Clinical applications I Chairs: *J. Bamber (The Institute of Cancer Research), J. Greenleaf (Mayo Clinic)*	
08:50	**Invited talk:** Challenges of breast ultrasound *H. Madjar (DKD HELIOS Klinik Wiesbaden)*
09:30	Ultrasound Tomography for Breast Cancer Screening *N. Duric (Delphinus Medical Technologies / Karmanos Cancer Institute), P. Littrup (Delphinus Medical Technologies)*
09:50	3D Ultrasound Tomography for Breast Cancer Diagnosis at KIT: an Overview *N. Ruiter, M. Zapf, T. Hopp, A. Menshikov, H. Gemmeke (Karlsruhe Institute of Technology)*
10:10	Breast Tissue Characterization with Sound Speed and Tissue Stiffness Imaging *C. Li, G. Sandhu, M. Boone, N. Duric, B. Kenneth, P. Littrup (Delphinus Medical Technologies)*

10:30	Coffee break

Session 9: Image processing Chairs: *P. Littrup (Delphinus Medical Technologies), R. Prager (University of Cambridge)*	
11:00	Postprocessing workflow of 3D-USCT: bridging the gap to the clinic *T. Hopp, M. Zapf, H. Gemmeke, N. Ruiter (Karlsruhe Institute of Technology)*
11:20	Tissue Characterization With Ultrasound Tomography Machine Learning *G. Sandhu, P. Littrup, M. Sak, C. Li, N. Duric (Delphinus Medical Technologies)*
11:40	Challenges and applications of registering 3D Ultrasound Computer Tomography with conventional breast imaging techniques *P. Cotic Smole, N. Ruiter (Karlsruhe Institute of Technology), N. Duric (Delphinus Medical Technologies), T. Hopp (Karlsruhe Institute of Technology)*

12:00	Lunch

Session 10: Clinical applications II Chairs: *N. Ruiter (Karlsruhe Institute of Technology), M. Zapf (Karlsruhe Institute of Technology)*	
13:20	**Invited talk:** Optoacoustic tomography and the pathway to commercialization *C. Wiest (iThera Medical GmbH)*
14:00	Feasibility study on USCT for brain imaging to estimate artifacts and image distortion caused by bone propagation *Y. Hayashi, H. Nakamura, X. Qu, D. Kondo, K. Yuge, T. Azuma, S. Takagi (The University of Tokyo)*
14:20	Multi-perspective ultrasound imaging of abdominal aortas *N. Petterson (Eindhoven University of Technology), M. van Sambeek (Catharina Hospital Eindhoven), F. van de Vosse, R. Lopata (Eindhoven University of Technology)*

14:40	Coffee break

Session 11: Clinical applications III Chairs: *J. Camacho (Spanish National Research Council), G. Sandhu (Delphinus Medical Technologies)*	
15:00	A simple method for acoustic properties determination of cancerous tissue and its implementation into the clinical workflow *F. Wolfram (Lung Cancer Center SRH Waldklinikum Gera)*
15:20	Clinical ultrasound breast tomography using Softvue®: a preliminary in vitro and in vivo assessment *J. Bamber (The Institute of Cancer Research), J. Fromageau, A. Messa, S. Bernard (Institute of Cancer Research and Royal Marsden NHS Foundation Trust), N. Duric (Delphinus Medical Technologies, Karmanos Cancer Institute, Wayne State University), A. D'Aquino, A. Ledger, M. Schmidt, M. Schoemaker, A. Swerdlow, E. O'Flynn (Institute of Cancer Research and Royal Marsden NHS Foundation Trust)*
15:40	The New Generation of the KIT 3D USCT *H. Gemmeke, T. Hopp, M. Zapf, I. Peric, L. Berger, W. Tan, R. Blanco, R. Leys, N. Ruiter (Karlsruhe Institute of Technology)*

Discussion session Chairs: *N. Duric (Delphinus Medical Technologies), J. Bamber (The Institute of Cancer Research)*	
16:00-17:00	Discussion session on clinical applications

17:00	**Invited talk:** Potential impact of ultrasound tomography in the clinic *P. Littrup (Crittenton Hospital Rocheste, Delphinus Medical Technologies)*

17:40	Closing ceremony

Posters

(1) Comparison of two ray tracing methods for sound speed imaging
X. Fang, Y. Wu, M. Yuchi, M. Ding (Huazhong University of Science and Technology)

(2) Contrast resolution enhancement of Ultrasonic Computed Tomography (USCT) using a wavelet-based method – Preliminary results in bone imaging
P. Lasaygues, R. Guillermin, K. Metwally (Aix Marseille University, CNRS), S. Fernandez (Aix Marseille University, CERIMED, Marseille), L. Balasse (Aix Marseille University, INSERM, VRCM), P. Petit (Department of Pediatric and Prenatal Radiology, Timone Children-Hospital, APHM, Marseille), C. Baron (Aix Marseille University, CNRS)

(3) Fast reflectivity imaging in 3D using SAFT
N. Ruiter, T. Hopp, M. Zapf, H. Gemmeke (Karlsruhe Institute of Technology)

(4) Minimum-variance beamforming for ultrasound computer tomography imaging
S. Wang, M. Yuchi, J. Song, L. Zhou, Y. Peng, M. Ding (Huazhong University of Science and Technology)

(5) Piezofibre composite transducers for next generation 3D USCT
M. Zapf (Karlsruhe Institute of Technology), K. Hohlfeld (Fraunhofer IKTS Dresden), P. Pfistner (Karlsruhe Institute of Technology), S. Gebhart (Fraunhofer IKTS Dresden), C. Liberman (Karlsruhe Institute of Technology), A. Michaelis (Technical University Dresden), H. Gemmeke, N. Ruiter (Karlsruhe Institute of Technology)

(6) Improved temperature measurement and modeling for 3D USCT II
M. Zapf, A. Patel, A. Menshikov, N. Ruiter (Karlsruhe Institute of Technology)

(7) Visualisation of Ultrasound Computer Tomography Breast Data Set
N. Tan Jerome, Z. Ateyev, V. Lebedev, T. Hopp, M. Zapf, S. Chilingaryan, A. Kopmann (Karlsruhe Institute of Technology)

(8) Comparison of registration strategies for USCT-MRI image fusion: preliminary results
T. Hopp, P. Cotic Smole, N. Ruiter (Karlsruhe Institute of Technology)

(9) Measurement of the speed of sound, attenuation and mass density of fresh breast tissue
L. Keijzer (Delft University of Technology), M. Lagendijk (Erasmus MC Rotterdam), N. Stigter (Delft University of Technology), C. van Deurzen, K. Verhoef, W. van Lankeren, L. Koppert (Erasmus MC Rotterdam), K. van Dongen (Delft University of Technology)

(10) The USCT reference data base
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