ST 6: Medical Imaging

Time: Thursday 11:00–12:00 Location: H-HS II

ST 6.1 Thu 11:00 H-HS II

Contrast enhanced 3D X-ray histology: from preclinical to clinical applications — •Madleen Busse[1], Simone Ferstl[1], Melanie Kimm[2], Mark Müller[1], Enken Drecoll[3], Toni Bürkner[1], Sebastian Allner[1], Lorenz Hehn[1], Martin Dierolf[1], Klaus Achterhold[1], Julia Herzen[1], Daniela Pfeiffer[2], Ernst Rummeny[2], Wilko Weichert[3], and Franz Pfeiffer[1,2] — [1]Department of Physics and MSB, TU Munich, Garching, Germany. — [2]Department of Diagnostic and Interventional Radiology, TU Munich, Munich, Germany. — [3]Department of Pathology, TU Munich, Munich, Germany.

Histopathology is currently the diagnostic gold standard. It is, however, destructive providing only 2D information [1]. 3D X-ray histology overcomes these limitations by visualizing 3D tissue microstructure, which is essential for a holistic pathological characterization [2]. We recently developed a laboratory-based method enabling 3D virtual histology based on contrast enhanced nanoscopic X-ray CT [3]. Here, we present the application of this method to human biopsy samples. The CT slices reproduce crucial structures with a similar detail level as corresponding histological light microscopy images. Deeper insights into the 3D configuration of the tissue can be gained from our 3D data. In addition, compatibility with standard pathological stains highlights the feasibility of integrating our method into the pathological workflow. [1] S. K. Suvarna et al. (2013). Theory and Practice of Histological Techniques, Edn. 7th., Elsevier, Oxford. [2] M. Müller et al., Sci. Rep. 8 (1) (2018) 17855. [3] M. Busse et al., PNAS 115 (2018) 2293-2298.

ST 6.2 Thu 11:15 H-HS II

Photon-Counting Detectors for Conventional and Spectral Breast Imaging — •Mirko Riedel, Lisa Heck, Thorsten Sellerer, Korbinian Mechlem, Josef Scholz, Christian Petrich, Lorenz Birnbacher, Martin Dierolf, and Julia Herzen — Chair of Biomedical Physics, Department of Physics and Munich School of BioEngineering, Technical University of Munich, 85748 Garching, Germany

Contrast-enhanced spectral mammography (CESM) is used as method for follow-up examinations in case of uncertain mammography findings. CESM has been successfully demonstrated in case of narrow polychromatic [1] and quasi monochromatic spectra. By the introduction of energy-resolving photon-counting detectors to medical imaging research, novel imaging techniques have been developed. In order to evaluate the performance of these techniques, we compared different photon-counting detector systems on conventional mammography and CESM. Three methods to obtain an iodine image, including K-edge subtraction (KES) in two measurements, one-shot KES and a two-material decomposition [2], were investigated with novel detectors. The contrast-to-noise ratios for all three methods have been compared to evaluate their ability to depict the iodine distribution.

[1] Lewin, J. M., et al. "Dual-energy contrast-enhanced digital subtraction mammography: feasibility." Radiology 229.1 (2003)

[2] Mechlem, K., et al. "Spectral angiography material decomposition using an empirical forward model and a dictionary-based regularization." IEEE transactions on medical imaging 37.10 (2018)

ST 6.3 Thu 11:30 H-HS II

Breast Imaging with a Grating-Based X-Ray Phase Contrast Setup — •Wolfgang Gottwald[1], Lisa Heck[1], Lorenz Birnbacher[1,2], Karin Hellerhoff[3], Susanne Grandl[3], Josef Scholz[1], Christian Petrich[1], Mirko Riedel[1], Stephan Metz[2], Daniela Pfeiffer[2], and Julia Herzen[1] — [1]Chair of Biomedical Physics, Department of Physics and Munich School of BioEngineering, Technical University of Munich, Germany — [2]Department of Diagnostic and Interventional Radiology, School of Medicine and Klinikum rechts der Isar, Technical University of Munich, Germany — [3]Department of Diagnostic Radiology, Rotkreuzklinikum Munich, Germany

Previous studies have shown that phase-contrast and dark-field x-ray imaging have a great potential to improve the conventional absorption based method used for breast imaging. (Scherer, K et al. 2014 and Scherer, K et al. 2015) Especially dense breast tissue exhibits minor deviations in the attenuation-based signal, therefore resulting in low soft tissue contrast for absorption-contrast imaging. This can be circumvented by utilizing the electron density contrast with our phase-sensitive technique. In this study dark-field, phase-contrast and absorption signals can be obtained simultaneously by grating-based phase stepping. In order to further push grating-based phase-contrast for breast imaging, an existing setup at a laboratory x-ray source was optimized and its performance evaluated. In this work we aim to improve the image quality of breast imaging at the current setup by testing its capabilities with freshly dissected mastectomy samples.

ST 6.4 Thu 11:45 H-HS II

Measurement of Acoustic Properties of Passive Materials for the Use in 3D Ultrasound Computer Tomography Transducers — •Julia Koppenhöfer, Martin Angerer, and Nicole Ruiter — Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

The KIT is developing a 3D Ultrasound Computer Tomography (USCT) system for the early detection of breast cancer. The USCT system consists of 128 x 18 transducers with a centre frequency of 2.2MHz. These interchangeably send and receive ultrasound (US) pulses from which a 3D model of the breast is calculated.

To optimize the future USCT device in regard to image reconstruction performance, transducers with new materials and assemblies need to be simulated before the most promising ones are built and tested. The accuracy of these simulations depends on the properties speed of sound and acoustic impedance of the materials utilized in the transducers. Literature values either do not exist or are inaccurate as having been measured for outdated compositions of the material.

We measure the speed of sound of a material by placing a sample inside a water tank equipped with US emitter and receiver on opposite sides. The time lapse between sent and received signal is measured for different sample lengths and the speed of sound calculated from the slope. The density of each material is measured, and the acoustic impedance calculated from the density and speed of sound. In this talk, an overview of the 3D USCT system is given, methods to measure the speed of sound are discussed and results are presented.