

Selected research topics in Biomedical Engineering: Novel Phenotyping and Diagnostic Tools

Location: DBE Lecture Room 14.03.002, Gewerbestrasse 14, Allschwil

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*Phase contrast inline X-ray microscopy: From 2D projections to 3D
virtual histology of soft tissue samples*

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Abstract

X-rays weakly interact with matter and thus allow deep insights into the internal architecture of complex samples. The most commonly known and widely used contrast in classical radiology is based on absorption, yet it is not the only way to visualize internal structures. In fact, absorption is very low for soft tissue samples. A second imaging modality is phase contrast relying on the fact that matter shifts the phase of the transmitting X-rays. For soft tissues, this effect is much more pronounced than absorption contrast. However, phase contrast imaging requires specific setups allowing for partially coherent X-ray radiation as well as algorithmic tools to invert the recorded holographic intensities.

In the first part of this talk, inline holographic phase contrast for lensless coherent diffractive imaging is introduced. Phase contrast images are not as straight forward to interpret as absorption based projections. Different state-of-the-art phase retrieval methods are shown that decode the recorded interference patterns and enable image contrast proportional to the projected electron density of the sample. Next, an introduction to tomography is given opening up the possibility to visualize the sample in three dimensions and paving the way to virtual histology with resolution at the sub micrometer to nanometer length scale. In the second part of this talk, different laboratory settings for phase contrast imaging at the Institute for X-ray Physics in Göttingen are presented: among them a liquid-metal jet X-ray source and a nano-focus X-ray tube from Excillum. Furthermore, the GINIX endstation at PETRAIII/DESY is presented as an example of a synchrotron beamline for coherent holographic imaging at high resolution. In particular, full field projection imaging at high magnification, recorded by illumination with advanced x-ray waveguide optics, and examples of current studies in neuro-imaging are given.

Curriculum

Anna-Lena Robisch studied physics from 2007-2010 at Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany) and from 2010-2012 at Georg-August-Universität Göttingen (Germany) with main emphasis on biophysics and complex systems. She received her PhD covering the topic of near-field ptychographic phase retrieval in 2015 (supervisor: Prof. Tim Salditt) at the Institute for X-ray Physics at Georg-August-Universität Göttingen. After her PhD, she worked in the field of industrial software development with emphasis on tomographic algorithms that allow for a fast GPU-based iterative reconstruction of noisy data made-to-measure for veterinarian small animal CT scanners. Yet, academic research offers greater freedom and options for more fundamental research, such that in 2017 she rejoined the Institute for X-ray Physics.