ST 2: Advances in X-Ray Imaging I

Time: Wednesday 15:00–16:20 Location: H41

ST 2.1 Wed 15:00 H41

Pulmonary Emphysema Diagnosis using a preclinical small-animal x-ray Dark-Field Scanner — •Andre Yaroshenko[1], Felix Meinel[2], Martin Bech[1], Arne Tapfer[1], Astrid Velroyen[1], Konstantin Nikolaou[2], Alexander Bohla[3], Ali Önder Yildirim[3], Oliver Eickelberg[3], Maximilian Reiser[2], and Franz Pfeiffer[1] — [1]Department of Physics Technische Universität München, Germany — [2]Institute of Clinical Radiology, Ludwig-Maximilians-University Hospital Munich, Germany — [3]Institute of Lung Biology and Disease, Helmholtz Zentrum Munich, Germany

Pulmonary emphysema is one of the leading causes of morbidity and mortality worldwide that is difficult to detect using conventional x-ray radiographic methods. For emphysematous lungs with enlarged distal airspaces, x-ray scattering decreases and transmission increases, as has been demonstrated by the proof-of-principle experiments with brilliant x-rays from a synchrotron source. Therefore, combination of the transmission and dark-field signals leads to a novel diagnostic approach for pulmonary emphysema.

In this study, images of excised murine lungs with pulmonary emphysema and control lungs were acquired using a compact phase- and dark-field scanner with a polychromatic source and a cone-beam geometry. The data analysis revealed a clear distinction between the two groups in the per-pixel scatter plot. The main difference was observed in the angle of the distribution to the vertical.

The presented study reveals the high potential of the approach for the pulmonary emphysema diagnosis.

ST 2.2 Wed 15:20 H41

Characterization of filters applied in Filtered Back-Projection Reconstruction for absorption and differential phase-contrast imaging — •Karin Burger, Michael Chabior, and Franz Pfeiffer — TUM, München, Deutschland

In computed X-ray tomography, window functions like "Ram-Lak" and "Hamming" (absorption) or the "Hilbert filter" (phase-contrast) are commonly used for correct tomographic reconstruction and improvement of image quality in the back-projection process. Choosing the appropriate filter, i.e. the adequate weight of the spatial frequencies, is not obvious. For instance, the noise spectrum of phase-contrast tomography differs considerably from absorption tomography. Existing literature does not provide a clear comparison and characterization, neither of absorption nor of differential phase-contrast (DPC) filters corresponding to the target application. In this study, we examine the modulation transfer function (MTF) of a simulated phantom in contrast to its tomographic reconstructions, obtained by forward- and filtered back-projection with different filters. We thereby optimize the reconstruction with respect to sharpness of edges as well as to remaining noise. Those parameters are especially studied using the "Hilbert filter" in order to improve frequency weighting, considering amongst others the half-pixel shift method introduced in earlier studies. As a result, we provide a set of rules to facilitate the choice of the appropriate filter for both, absorption and DPC tomography. In biomedical imaging, this filter selection allows for individual contrast enhancement depending on the structure of interest (e.g. bones, soft tissue).

ST 2.3 Wed 15:40 H41

Influence of image processing on noise, sharpness and quantitativeness in grating-based phase-contrast imaging — •Mathias Marschner[1], Marian Willner[1], Dieter Hahn[1], Alexander Hipp[1], Julia Herzen[3], Michael Chabior[1,2], and Franz Pfeiffer[1,2] — [1]Physik Department, Technische Universität München, 85748 Garching, Germany — [2]Institute of Medical Engineering, Technische Universität München, 85748 Garching, Germany — [3]Institute of Materials Research, Helmholtz-Zentrum Geesthacht, Max-Planck-Str.1, 21502 Geesthacht, Germany

Grating-based phase-contrast x-ray imaging provides additional contrast compared to regular absorption based x-ray imaging. The technique has been adapted to work with conventional x-ray tube sources and allows for quantitative imaging.

The choice of processing and tomographic reconstruction algorithms influences the image quality and quantitativeness of the computed tomography. We will present an overview of different methods for processing and CT-reconstruction (conventional and iterative) as well as subsequent filtering. The comparison focuses on noise, sharpness and quantitativeness using simple phantoms and biomedical samples measured at a grating interferometer equipped with a polychromatic x-ray tube and a photon counting detector.

ST 2.4 Wed 16:00 H41

Simulation des Dunkelfeldes in der Röntgen-Talbot-Lau-Interferometrie: Vergleich mit Messungen und mögliche Näherungen — •André Ritter, Florian Bayer, Jürgen Durst, Christoph Hertle, Florian Horn, Thilo Michel, Georg Pelzer, Jens Rieger, Andrea Zang, Thomas Weber und Gisela Anton — Erlangen Centre for Astroparticle Physics, FAU Erlangen-Nürnberg, Erwin-Rommel-Str. 1, 91058 Erlangen

Das Dunkelfeldbild in der Röntgen-Talbot-Lau-Interferometrie ermöglicht es Strukturen unterhalb der Auflösungsgrenze in Proben zu detektieren. Das Dunkelfeldsignal kann mit skalarer Beugungstheorie simuliert werden. Dies wird in Vergleichen mit Messungen gezeigt.

Die Propagation eines Wellenfeldes durch eine Probe kann mit der Projektionsnäherung erfolgen. Diese Näherung ist jedoch nicht für alle Proben geeignet. Eine mögliche Verbesserung wird mit dem Mehrschicht-Verfahren erreicht. Bei diesem wird die Probe in mehrere in Propagationsrichtung aufeinanderfolgende Schichten eingeteilt und die Wellenfeldpropagation erfolgt schrittweise von Schicht zu Schicht.

Als zusätzliche Näherung kann die dreidimensionale Simulation in Schichten entlang der Propagationsrichtung senkrecht zu den Gitterstegen eingeteilt werden. Diese Schichten können wegen der geringen räumlichen Kohärenz in Richtung der Gitterstege in zweidimensionalen Simulationen unabhängig behandelt werden. Die Ergebnisse werden im Anschluss wieder zu einem Gesamtergebnis zusammengesetzt.

Es werden Rechenaufwand, Ergebnisse und Vorraussetzungen der genannten Verfahren untersucht.