Master project plan

Master project at the Department for Radiation Oncology, Technical University of Munich, Institute of Radiation Medicine (IRM) Helmholtz Centre Munich and the Institute of Health and Medical Research (Inserm), UA7 Strobe and Grenoble Alpes University in Grenoble, France

Project title: X-ray phase contrast and dark field imaging with a novel compact x-ray source

Background: While classical x-ray imaging measures the absorption of x-ray radiation in a specimen, also phase shift and small angle scattering of x-rays can be used to create imaging contrast. Such imaging techniques are known as phase contrast and dark field x-ray imaging. They provide additional information on the microstructure of biological structures and exhibit improved soft tissue contrast compared to conventional computed tomography, which can substantially improve the diagnosis of diseases such as lung cancer and pathological changes.

PCI has not yet found entrance into clinical use since the development of phase contrast imaging for clinical applications puts special requirements on the radiation source, such as spatial coherence. In Munich, we are currently developing and constructing a new radiation source, called the line focus x-ray tube (LFxT) that produces 300 kVp x-rays from a 50 µm wide and 20 mm long focal spot. Dr. Emmanuel Brun at Inserm UA7 Strobe in Grenoble developed novel phase contrast imaging techniques, such as speckle tracking at the European Synchrotron. In a collaboration, we want to investigate the suitability of the line focus x-ray tube for such phase contrast imaging techniques.

This master project will assess the suitability of the line focus x-ray tube for phase contrast imaging in simulations and identify challenges and chances for applications in medicine and material sciences. Substantial parts of the project will be carried out in Grenoble, France.

Methods and tasks:

- Familiarize with the simulation tools for PCI at Inserm in Grenoble
- Model the line focus x-ray tube (LFxT) in this simulation tool and carry out studies on synthetic phantoms
- Investigate the effect of the strongly eccentric focal spot and investigate means to generate high resolution and high contrast in 2D
- Study the limits of PCI with the LFxT and elaborate possibilities to improve the current design of the radiation source for imaging applications

Time schedule

Month of Master project	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Literature	**X**	**X**										
Familiarize with simulation tools	**X**	**X**	**X**									
Perform simulations for a synthetic phantom			**X**	**X**	**X**							
Develop means for high resolution imaging					**X**	**X**	**X**	**X**	**X**			
Study limits of LFxT in PCI								**X**	**X**	**X**	**X**	
Write thesis											**X**	**X**

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