



Doktorarbeit / PhD Thesis

Development of X-ray phase contrast imaging techniques for medical diagnostics: towards clinical applications

General framework

Since their discovery more than one century ago, X-ray radiation has become a powerful and unique tool in medical diagnostics. Despite its invaluable contribution to patient care, the sensitivity of X-ray diagnostics is drastically limited in the examination of soft tissues because of their weak absorption properties.

Over the last two decades, a major improvement has been introduced by phase contrast imaging (PCI) that has demonstrated unprecedented potential to improve the diagnostics work-up. Unlike standard radiology, the new imaging modality relies on the fact that X-rays are not only absorbed but also refracted (i.e. phase shifted) when passing through matter. This may allow for visualization of contrast in light tissues since the phase effects are order of magnitude higher than absorption ones in the radiological X-ray energy range.

The aim of our research is to optimize PCI techniques by studying *in-vitro* and *in-vivo* medical relevant cases. Presently we are focused on two major areas that are breast cancer and osteoarthritis detection, but other medical application could be considered in the future.

Highly collimated and partially coherent synchrotron radiation is used as gold standard radiation for the development of PCI, with the objective of implementing these techniques at compact high brilliant and high energetic X-ray sources presently under development around the world.

This study includes the comparison of the different PCI methods (crystal-, propagation-, grating-based techniques) for specific medical applications. Major aspects include image quality, diagnostic accuracy, and radiation dose exposure.

This research is performed in the framework of a multidisciplinary team of complementary expertise formed by physicists of the LMU / TU (Munich) and of the European Synchrotron Radiation Facility (ESRF, Grenoble, France) and clinical partners at the department of clinical radiology (LMU, Munich).

Description of the thesis work

The proposed PhD work will be specifically addressed 1) to assessment of the radiation dose in the case of high resolution phase contrast tomography and 2) to develop technical prerequisites (hardware and software) for implementation of the method to patient care.

The development of a software platform to compute the 3D distribution of the dose deposited in tissue samples during monochromatic synchrotron radiation micro-CT is a primary need for this project. Experimental validation of the code will be performed as well.

Comparison of several PCI techniques in terms of sensitivity and dose requirements for specific medical cases together with the development of pattern recognition methods for the automatic differentiation of normal and diseased tissues represent the other focus of the PhD work.

We require enthusiasm for experimental work, excellent grades and some experience with scientific computing software (e.g. Matlab®, IDL etc.).

Student interested in this position shall provide the following documents (in English):

1. CV including a summary of the education / scientific background and personal skills
2. University grades and copy of their degree
3. A cover letter including the motivation for applying to this position

Applications have to be submitted by e-mail and normal post. The contact details are:

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