Research focus of the department of “Physics of Molecular Imaging Systems” (PMI) is on exploring the physical limits of current and future molecular imaging technologies. These areas range from simulations of new detector concepts, hardware prototypes, high speed data processing, image reconstruction algorithms and applications using our research imaging prototypes. Our group consists of students and researchers from different disciplines: physics, engineering, computer science and medicine. PMI is part of a large international network with a close link to industry, particularly to Philips Research.

**Master’s Thesis: Development and Construction of an Automated Optical Test Bench for Evaluation of PET Scintillators**

In Positron Emission Tomography (PET) imaging (Fig. 1), a patient or animal is injected with a radioactive substance emitting positrons during decay. The positron annihilates with an electron from the subject’s body, thus producing two photons which have to be detected outside the body by the PET detectors. These PET detectors are typically scintillators, converting the 511 keV gamma photon to a high number of optical photons, which are detected by underlying photosensitive detectors.

PET scintillators are often segmented into compartments to optically separate the scintillators from each other. In current system designs staggered scintillator arrays, with up to four layers are used to determine also the depth-of-interaction (DOI) of the gamma photons (Fig. 2b).

However, the manufacturing of staggered scintillator arrays, particularly those with small segment pitch (e.g. 1-2 mm), is challenging and for each of the 50-100 arrays in a typical PET detector the exact position of the individual scintillator blocks has to be verified for quality control.

For this purpose, we aim to set up an automated test bench for classification of the manufactured arrays. In a further step, the setup shall be used to check the mounting of the scintillator blocks to the photodetectors. The test bench will consist of two telecentric optics (with two different magnifications, allowing either an overview image of the whole object or a high-resolution image of a limited subregion), digital cameras and motorized translation stages.

The candidate will be responsible for the mechanical integration and the development of the testbench software. This includes interfacing the cameras and translation stages as well as image processing. The latter includes:

- Stitching of the high resolution images in x,y direction and for different focal depths
- Registration of the stitched to the overview image and to a physical reference
- Feature extraction of the scintillator block in order to allow a quality testing of scintillator’s geometry and in a second step the assembly of the scintillator array to the photodetector.

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