Novel multimodal endoscopic probes for simultaneous PET/ultrasound imaging for image-guided interventions

Berichterstattung

Final Report Summary - ENDOTOFPET-US (Novel multimodal endoscopic probes for simultaneous PET/ultrasound imaging for image-guided interventions)

The ENDOTOFPET-US project aims at developing new cancer biomarkers with a specific focus on prostatic and pancreatic cancers, entities with almost asymptomatic development and, in the case of pancreatic cancer, very bad prognosis if not detected and treated early.

A new, higher performance imaging tool with multimodal capability has been developed in the frame of this project, introducing breakthrough technologies for novel endoscopic procedures in diagnostic and therapeutic endoscopy and in surgical oncology aiming at diagnosing more patients with earlier tumour stages and improving patient outcome and therapy, as well as reducing health costs. The system aims at a very high sensitivity allowed by the endoscopic approach and the proximity of the target, a spatial resolution of 1mm to delineate early tumors, and a time resolution of 200ps to reject by time-of-flight techniques the high background due to the other organs, as this is the first time part of a PET system is
inside the patient.

The system consists of a miniaturized PET head installed on a commercial ultrasound endoscope and an outer PET plate placed outside the body in coincidence with the PET head. The two detectors need to be positioned with respect to each other to a precision of better than a millimeter for the duration of the examination. This task is performed by a combination of optic and electromagnetic tracking systems. Each of the two detectors consists of LYSO inorganic scintillators to convert the 511keV photons from positron-electron annihilation to scintillation light. The crystals are coupled one-to-one to blue-sensitive photo-detectors optimized for ultimate timing resolution. The signals of the photo-detectors are digitized either in the photo-detectors itself (with a multi-digital pixellated photodetector developed specifically for this project), or via additional off-detector electronics for the external plate. The system is controlled by an off-detector data acquisition and slow control system. The compact data acquisition system handles rates up to 40 MHz from the external plate and 200 kHz from the internal probe. Specific programmable circuits (FPGA) on the front-end boards concentrate the event data from the external plate and transmit it to an external trigger. The data acquisition card then merges these data with the one from the internal probe allowing a selection of coincidence events.

Two versions of this device have been built, one for the prostate and one for the pancreas. Preclinical tests have been conducted on pigs with the prostate version and have led to very encouraging results. The system is now ready for systematic investigations of new and very promising biomarkers, such as 68Ga-PSMA and 68Ga-Bombesin for the prostate and a new antibody developed by one partner of the consortium for the pancreas (16D10 glycosylated antigen).

The project documentation is continuously updated on a web site with public and private sections (http://endotofpet-us.web.cern.ch/).

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