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ThyroPIX – Mobile Compton camera based on Timepix3 technology for imaging in the field of preclinical and clinical praxis

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The preclinical studies and clinical tests are an indispensable part of the research of new drugs and methods for cancer treatment. The emission imaging techniques such as SPECT (Single Photon Emission Computed Tomography) and PET (Positron Emission Tomography) belong among these methods, allowing observation of physiological and pathological processes. Each of these techniques requires different radioisotopes, use of different scintillator cameras and they are based on a totally different principle of detection. SPECT and PET modalities must be used separately for these reasons.

Imaging using a fully spectral single-photon counting detector of new generation based on Timepix3 technology exploits the ability to measure position, energy and time of every detected particle. Thanks to time information related to charge drift speed it is possible to determine the depth of interaction of the primary photon and the scattered photon in one layer of sensitive material. The direction of a primary photon is then calculated and based on the backward reconstruction the source is localized in space. This new concept brings possibilities of emission imaging using a single layer Compton camera for various types of radioisotopes of broad range of energies. This approach leads to the development of a unique multimodality system without using any other usually necessary equipment (e.g. heavy collimators). Besides the absence of collimators, the main benefits of the novel system include low weight and significantly higher sensitivity.

ThyroPIX is a new generation multimodal device for imaging the thyroid gland and small organs by nuclear medicine methods. The main advantages of the ThyroPIX device are the ability to detect high photon fluxes and display with high spatial resolution. Thanks to the implementation of the detector on a mobile collaborative robotic arm and the execution of either a planar or tomographic image, it will be possible to perform a quick, basic examination of the patient in any part of the hospital.

The presented results were measured using ADVAPIX Timepix3 detectors with CdTe sensor material of thickness 2 mm. This contribution shows the first pilot test using a single layer Compton camera for imaging of the thyroid gland during radiotherapy by ^{131}I in clinical practice as well.

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