



Contribution ID: 24

Type: Oral

ThyroPIX – Mobile Compton camera based on Timepix3 technology for monitoring of thyroid gland cancer treatment

Thursday, 29 June 2023 09:20 (20 minutes)

Thyroid tumors are relatively rare, but their incidence is steadily increasing in recent times. The goal of preclinical and clinical studies is therefore to find a way to detect and successfully treat this type of cancer early. The main problem is that the current imaging methods don't provide sufficient spatial resolution to reveal the remnants after the surgical removal of the gland. Due to their presence the disease relapses. ThyroPIX is a new-generation multimodal device for imaging the thyroid gland and thyroid cancer treatment monitoring. The ThyroPIX device is equipped with a fully spectral single-photon counting detector of a new generation based on Timepix3 technology which exploits the ability to measure the position, energy, and time of every detected particle. Thanks to this information related to very precise time detection of every incoming gamma photon is possible to determine the position of the interaction of primary and Compton scattered photons in sensitive layers of detector materials. Together with the energy information direction of a primary photon is then calculated and based on the backward reconstruction the source is localized in space. This new imaging method concept called the Compton camera brings possibilities of emission imaging for various types of radioisotopes of a broad range of energies. This approach leads to the development of a unique 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 better spatial resolution, low weight, and significantly higher sensitivity. 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. This contribution presents the imaging system and shows the measured data and its results in the framework of preclinical tests on phantoms.

[1] TURECEK, D., J. JAKUBEK, E. TROJANOVA a L. SEFC. Compton camera based on Timepix3 technology. Journal of Instrumentation [online]. 2018, 13(11)

[2] TURECEK, D., J. JAKUBEK, E. TROJANOVA a L. SEFC. Single layer Compton camera based on Timepix3 technology. Journal of Instrumentation [online]. 2020, 15(01)

Acknowledgment

This project was implemented with financial support from the state budget through the Technology Agency of the Czech Republic in project FW01010471.

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Session Classification: Applications

Track Classification: Applications