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MoTI, a mobile gamma camera for therapeutic dose control during targeted radiotherapy

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Targeted radionuclide therapy is the most used treatment modality against malign and benign diseases of thyroid. The large heterogeneity of therapeutic doses in patients and the range of effects observed state that an individualized dosimetry is essential for optimizing this therapy. The goal of the project is to strengthen the control of the doses delivered to thyroid during treatment of benign and malign diseases, providing a novel mobile gamma imaging device specifically dedicated to measurements of the bio-distribution and kinetics of the radio-tracer at the patients's bedside.
We report the optimization of the detection head of the camera, made by both experiments and Monte Carlo simulations, and the preliminary experimental results obtained with the first fully operational 5×5 cm2 FoV camera prototype. It consists of a 3D printed parallel-hole high-energy tungsten collimator, coupled to a 6 mm thick continuous CeBr3 scintillator, readout by an array of Silicon Photomultiplier detectors. The camera exhibits an intrinsic spatial resolution of 0.8 mm FWHM at 356 keV with very low distortion and an energy resolution of 8%. The optimization of the collimator design, in order to enhance small nodules detectability by reducing scatter and septal penetration, leads to the choice of a 5.5 cm thick collimator with a spatial resolution of 2 mm and an efficiency of 1.24×10−5 for a 5 cm source distance. Preliminary imaging with thyroid phantoms filled with 131-I shows the huge improvement of image quality compared to a standard high-energy gamma-camera. Detailed description of the MoTi camera optimization will be presented.

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