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A temperature calibration method using dynamic energy windows for the online blood radioactivity meter

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In nuclear medicine, the online blood radioactivity meter measures the radioactivity in the blood vessel to form the arterial input function in a dynamic PET study. Such a radioactivity meter is composed of scintillation crystals and SiPMs. The accuracy of the activity measurement varies with the temperature due to the temperature dependency in the gain of SiPMs and the light output of crystals. We aim to propose an algorithm to correct the effect of temperature changes on photon counts based on a floating energy window.
This algorithm calculates the energy window according to the real-time energy spectrum. It finds peaks of the energy spectrum and fits them with Gaussian functions. The intersection points of the Gaussian functions are then used to determine the energy window. The radioactivity meter finally outputs the number of coincidence events within this floating energy window after the radioactive decay and detection sensitivity are corrected.
When the radioactive source 22Na with a long half-life is measured, the proposed method shows a coefficient of variation of 0.0037, while the fixed energy window method and the normalized energy window method have 0.0946 and 0.0067. For the commonly used 18F-FDG, the proposed method outperforms the other two with a smaller error during the period when the temperature increases. The relative error remains less than 5% in the first half-life of the source.
Experimental results show that we proposed a simple and robust method to calibrate the online blood radioactivity meter so that the readout is stable when temperature varies.

Minioral

Yes

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Yes

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