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Screen 02 - Assessing the robustness of radiomics feature measurements using the noise equivalent count rate, and the future role of Total Body PET

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Radiomics, the term given to a feature-based approach to image analysis, suffers when used with inherently noisy PET data due to the convoluted derivation of many features and an overall lack of uncertainty provision. The noise equivalent count rate (NECR) is a scanner- and geometry-dependent metric which is primarily used to verify scanner performance. The characteristic variation of the NECR with activity in the field of view prompts discussion over its potential use to predict radiomics feature values at injected activities with an optimum signal-noise ratio. Our study began by scanning a cylindrical phantom filled with FDG solution for alternating 5 and 25 minute acquisitions, presenting 48 total frames. This was repeated twice using our own custom 3D-printed anthropomorphic tumour phantom inserts for the NEMA Image Quality phantom. 32 radiomics features from texture matrices were observed to correlate well (Pearson product moment correlation coefficient \(|\text{PMCC}| \geq 0.9\)) with NECR for the 25 minute frames, enabling estimation of 'compensation factors' from the values at clinical injection activity levels. Correlations with NECR fall across all metrics for 5 minute scans, with the |PMCC| of the ten previously highest-correlating features falling by an average of (11.5 ± 6.6) %. Feature correlations to 'global' NECR also decrease for small 'local' ROIs as observed in our custom phantom scans. Total Body PET systems have reported a 4-fold increase in sensitivity in comparison with conventional scanners for activity in the field of view, such that equivalent scan signal-noise ratio can be achieved in one quarter of the total scanning time. This study considers how the dual influence of increased sensitivity and choice of noise-representative metric may lead to a method for estimating uncertainty on these radiomics features.

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