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A Comparison of Various Attenuation Map Generation Methods for MR Coils in PET/MR

To achieve quantitatively accurate PET images, careful consideration of photon attenuation and scatter is essential. In PET/MR, patient attenuation and scatter correction (ASC) factors are often estimated using pseudo-CT images derived from MR images. Additionally, ASC due to MR hardware is addressed by registering a previously calculated attenuation map for MR coils to the patient attenuation maps given their positions. In this study, we investigate various methods for calculating MR coil attenuation maps and demonstrate their effects on PET quantification. Attenuation maps of an MR head and neck coil were calculated using single-energy CT, dual-energy CT, photon-counting CT, and 511 keV transmission imaging. PET images of a uniform phantom inserted within the head and neck coil and reconstructed using different attenuation maps were compared against the case of ignoring the coil in the attenuation maps. Analysis of the reconstructed PET images revealed average quantitative errors of (5.4 ± 3.1)%, (2.0 ± 2.7)%, (-1.1 ± 1.8)%, (-2.6 ± 1.1)%, and (-15.3 ± 5.4)% when using single-energy CT, dual-energy CT, photon-counting CT, transmission-based, and ignoring coil attenuation maps, respectively. Analysis of the reconstructed PET images suggested that visual artifacts and quantitative errors appear when using standard single and dual-energy CT attenuation maps, and that photon-counting CT is likely the most reliable approach for estimating hardware attenuation maps in PET/MR.

Field

Software and quantification

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