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Potential of Metal Artifact Reduction (MAR) and Deep Learning-based Reconstruction (DLR) algorithms integration in CT Metal Artifact Correction: A review

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Abstract

Computed Tomography (CT) is essential for precise medical diagnostics, yet metal implants often induce disruptive image artifacts. Metal Artifact Reduction (MAR) algorithms have emerged to enhance CT image quality by mitigating these artifacts. This review emphasizes the significance of quantifying MAR algorithms, details common quantification metrics, and presents findings from diverse CT scanner studies. MAR techniques effectively reduce metal artifacts and enhance CT imaging. Metrics like noise levels, Contrast-to-Noise ratio (CNR), CT number accuracy, and Metal Artifact Index (MAI) quantify their efficacy. Varied CT scanner experiments with diverse metal implants display improved CT number accuracy, noise reduction, and artifact management through MAR algorithms. However, secondary artifacts and altered metal size accuracy are potential drawbacks that need attention. Deep Learning-based Reconstruction (DLR) is an expanding approach using Artificial Intelligence (AI) for CT image reconstruction. DLR generates low-dose CT images with high spatial resolution. Recent clinical deployments highlight DLR's potential in generating low-noise, texture-rich images, and superior artifact reduction. Moreover, DLR techniques exhibit promise in addressing beam hardening artifacts. While MAR algorithms have revolutionized CT imaging, DLR techniques are emerging as potential alternatives. Current DLR implementations like TrueFidelity and Advanced Intelligent Clear-IQ Engine (AiCE) demonstrate promising outcomes. However, challenges in implementation and machine learning model reliability require further exploration. In conclusion, MAR algorithms enhance CT imaging quality by rectifying artifacts near metal implants, while DLR methods offer a promising path for radiation dose reduction and image refinement. Combining both approaches might pave the way for future CT imaging advancements.

Author Keywords

Computed tomography; Deep learning reconstruction; Image quality; Metal artifact reduction; Reconstruction algorithm

Index Keywords

Computerized tomography, Deep learning, Diagnosis, Grain refinement, Image enhancement, Image reconstruction, Learning algorithms, Learning systems, Medical imaging, Noise abatement, Textures; Computed tomography, Computed tomography images, Computed tomography scanners, Deep learning reconstruction, Metal artifact reduction, Metal artifacts, Reconstruction algorithms, Reconstruction techniques, Reduction algorithms, Tomography imaging; Image quality; artifact reduction, computer assisted tomography, contrast to noise ratio, deep learning, dosimetry, dual energy computed tomography, human, image quality, image reconstruction, model based iterative reconstruction, partial volume (imaging), planning target volume, radiation dose reduction, radiotherapy, reconstruction algorithm, Review, signal noise ratio

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