Abstract: Metal Inpainting in CBCT Projections using Score-based Generative Model

Siyuan Mei, Fuxin Fan, Andreas Maier

Pattern Recognition Lab, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany
siyuan.mei@fau.de

During orthopaedic surgery, the insertion of metallic implants or screws is often performed under mobile C-arm systems. However, due to the high attenuation of metals, severe metal artifacts occur in 3D reconstructions, which degrade the image quality significantly. Therefore, many metal artifacts reduction (MAR) algorithms have been developed to reduce the artifacts. In this work, a score-based generative model is trained on simulated knee projections to learn the score function of the perturbed data distribution, and the inpainted images are obtained by removing the noise during the conditional sampling process [1]. Specifically, the backbone of the score-based neural network is a simple U-Net which is conditioned on a time variable while the perturbation kernel utilizes the variance exploding form. A hyperparameter sweep is conducted to confirm the optimal hyperparameters in the sampling process, revealing that a signal-to-noise ratio of 0.4 and a number of discretization steps equal to 1000 achieve the best trade-off between efficiency and accuracy. Finally, the result implies that the inpainted images by the proposed unsupervised method have more detailed information and semantic connection to the bones or soft tissue, achieving the lowest mean absolute error of 0.069 and the highest peak-signal-to-noise ratio of 43.07 compared with the inverse distance weighting interpolation method and the mask pyramid network. Besides, the score-based generative model can also recover projections with large circular and rectangular masks, showing its generalization in inpainting tasks.

References

1. Mei S, Fan F, Maier A. Metal inpainting in CBCT projections using score-based generative model. Proc IEEE ISBI. 2023:1–5.

A. Maier et al. (Hrsg.), *Bildverarbeitung für die Medizin 2024*,
Informatik aktuell, https://doi.org/10.1007/978-3-658-44037-4_86