How Does AI Handle Motion Artifacts in Medical Images?

Rasit Dinc

Rasit Dinc Digital Health & AI Research

Published: March 15, 2017 | AI in Medical Imaging and Diagnostics

DOI: 10.5281/zenodo.17999068

Abstract

Motion artifacts are a significant challenge in medical imaging, often leading to degraded image quality, diagnostic inaccuracies, and the need for costly an...

How Does AI Handle Motion Artifacts in Medical Images?

Author: Rasit Dinc

Introduction

Motion artifacts are a significant challenge in medical imaging, often leading to degraded image quality, diagnostic inaccuracies, and the need for costly and time-consuming rescans. These artifacts, caused by voluntary or involuntary patient movement during image acquisition, can obscure critical anatomical details and compromise the reliability of diagnostic procedures. Fortunately, the advent of artificial intelligence (AI), particularly deep learning (DL), has opened up new frontiers in mitigating motion artifacts, promising to enhance image quality, improve diagnostic confidence, and streamline clinical workflows [1].

The Role of AI in Motion Artifact Correction

AI-powered techniques for motion artifact correction can be broadly categorized into two main approaches: **prospective** and **retrospective** correction. Prospective methods aim to detect and compensate for motion in real-time during the image acquisition process, while retrospective techniques are applied to images that have already been corrupted by motion artifacts.

Prospective Motion Correction

Prospective motion correction techniques leverage AI algorithms to actively track patient movement and adjust the imaging parameters accordingly. For instance, convolutional neural networks (CNNs) can be trained to analyze real-time data from motion sensors or navigators to estimate the patient's

position and orientation. This information is then used to update the acquisition sequence, ensuring that the resulting image is free from motion-induced distortions. While prospective methods are highly effective, they often require specialized hardware and can be challenging to implement in routine clinical practice [1].

Retrospective Motion Correction

Retrospective motion correction, on the other hand, has emerged as a more flexible and widely applicable approach. These methods utilize DL models to "learn" the relationship between motion-corrupted and motion-free images, enabling them to effectively remove artifacts from existing scans. Generative adversarial networks (GANs) and other generative models have shown remarkable success in this area. These models are trained on large datasets of paired images (with and without motion artifacts) and learn to generate a clean image from a corrupted input. This data-driven approach allows for the correction of a wide range of motion artifacts, from subtle blurring to severe distortions [1]. A recent study has also demonstrated the use of a CNN to filter motion-corrupted images and then use k-space analysis to detect and reconstruct the image from unaffected data [3].

Challenges and Future Directions

Despite the significant progress in AI-based motion correction, several challenges remain. One of the primary limitations is the need for large, high-quality datasets of paired images for training DL models. The collection and annotation of such datasets are time-consuming and labor-intensive. Furthermore, the generalizability of AI models to different imaging modalities, patient populations, and motion patterns is an ongoing area of research. Future work will likely focus on the development of more robust and data-efficient DL architectures, as well as the integration of AI-based motion correction techniques into clinical workflows. For example, AI can be used to estimate the severity of motion artifacts and select the most appropriate reconstruction model for a given scan [2].

Conclusion

AI is revolutionizing the field of medical imaging, and its application to motion artifact correction is a prime example of its transformative potential. By leveraging the power of deep learning, we can significantly improve the quality and reliability of medical images, leading to more accurate diagnoses, improved patient outcomes, and reduced healthcare costs. As AI technology continues to evolve, we can expect to see even more sophisticated and effective solutions for tackling the challenge of motion artifacts in the years to come.

References

[1] Safari, M., Eidex, Z., Qiu, R. L., Goette, M., Wang, T., & Yang, X. (2025). Systematic Review and Meta-analysis of AI-driven MRI Motion Artifact Detection and Correction. *ArXiv*. https://arxiv.org/abs/2509.05071 [2] Beljaards, L., Pezzotti, N., Rao, C., Doneva, M., van Osch, M. J. P., & Staring,

M. (2024). AI-based motion artifact severity estimation in undersampled MRI allowing for selection of appropriate reconstruction models. *Medical Physics*, *51*(5), 3555–3565. https://doi.org/10.1002/mp.16918 [3] Cui, L., Song, Y., Wang, Y., Wang, R., Wu, D., Xie, H., Li, J., & Yang, G. (2023). Motion artifact reduction for magnetic resonance imaging with deep learning and k-space analysis. *PLOS ONE*, *18*(1), e0278668. https://doi.org/10.1371/journal.pone.0278668
