

EFFICIENT MULTI-DIMENSIONAL 4D MRI AND PET/MR MOTION CORRECTION

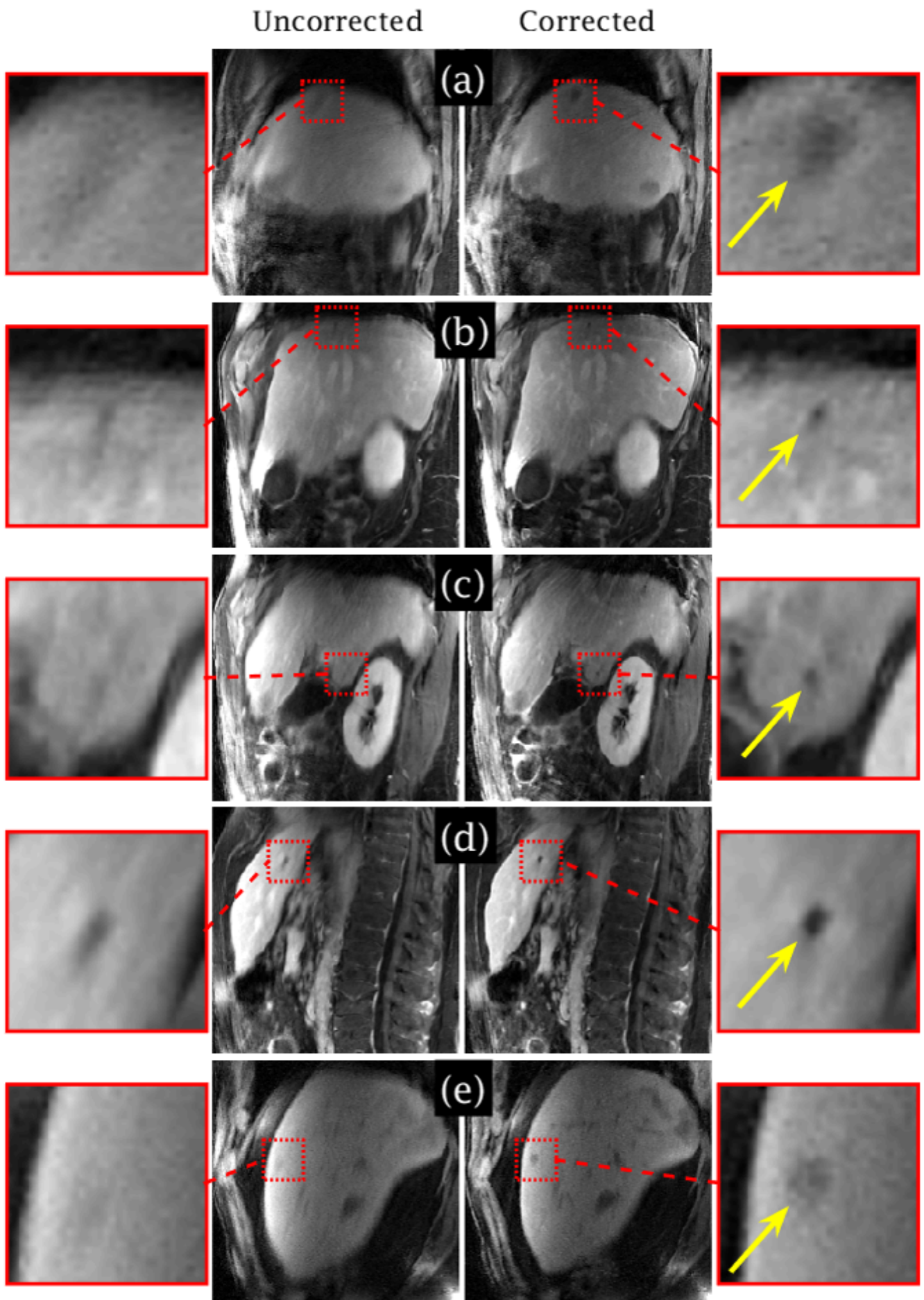
[An, Hongyu](#), [Eldeniz, Cihat](#)

[Dahl, Lisa](#)

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Technology Description

Researchers in Prof. Hongyu An's laboratory have developed a new image processing system for faster acquisition of motion-corrected MR or PET/MR images. This technology could be expanded to multiple sampling schema to correct both respiratory and cardiac motion.



Liver tumor patient lesions observed by PET/MRI, with and without motion correction

Patient movement (such as breathing) can cause artifacts and blurring of 4D MR images which then hinders accurate imaging for tumor staging or radiation therapy treatment planning. Currently, techniques for motion correction either require the patient to hold their breath or use navigator-based techniques that extending total scan time. This technology solves these problems with an automated self-navigating method that provides a direct imaging measurement of moving organs without additional RF pulses. The approach shortens the data acquisition time and does not disturb magnetization. Additional machine learning techniques could allow motion correction for PET images as well. This reliable, flexible, efficient motion resolution system could enhance lung, liver, and heart imaging and thereby improve diagnostics and treatment planning for lung cancer and other disorders.

Stage of Research

The inventors have implemented this system and demonstrated that it can reduce motion artifacts in upper abdominal MR images.

Applications

- **MRI and PET/MR image processing** – motion correction, particularly for respiratory and cardiac movements

Key Advantages

- **Faster acquisition times:**
 - intrinsic, automated motion correction replaces standard imaging shot with no additional MRI measurements/scanning, RF pulses or monitors
 - adaptive compressed sensing reconstruction reconstructs images from less data than current techniques
 - does not disturb magnetization
- **Patients breathe freely**
- **Multi-dimensional correction** – could be expanded to multiple sampling schema such as combining correction for respiratory and cardiac motion in heart imaging

Publications

- Eldeniz C, Chen Y, & An H. (2016). [Cosine-modulated acquisition cleans spectra for better respiratory cine.](#) *Proceedings of the 24th Annual Meeting of ISMRM.*
- Eldeniz C, Fraum T, Salter A, Chen Y, Gach HM, Parikh PJ, Fowler KJ, An H. (2018). [CAPTURE: Consistently Acquired Projections for Tuned and Robust Estimation: A Self-Navigated Respiratory Motion Correction Approach.](#) *Invest Radiol.* 53(5):293-305.
- Chen S, Eldeniz C, Laforest R, An H. (2019) [MR-assisted PET motion correction improves tumor-to-background and contrast-to-noise ratios in a phantom study with ground truth reference.](#) *Proceedings of the 27th Annual Meeting of ISMRM.*
- Chen S, Eldeniz C, Chen Y, An H. (2020) [Quantitative Assessment MR-Assisted PET Respiratory Motion Correction in Colorectal Liver Metastases using PET/MR.](#) *Proceedings of the 28th Annual Meeting of ISMRM.*

Patents: [Free-breathing and self-navigated mri method for deformable motion derivation](#) (U.S. Patent Application, Publication No. US20180204358A1)

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