MONASH University

Magnetic resonance image correction

MEDTECH: Diagnostics - Digital

The Challenge	Large amounts of data are acquired during an MRI scan, which is assembled during a post-processing step into a human interpretable image. The more data, the better the resulting image. The throughput of MRI machines is determined by the time it takes to complete a scan and whether scans have to be repeated due to poor image quality, which is often the result of patient movement. A better quality image results from longer scans but this involves increased risk of patient movement and results in reduced throughput and hence a lower number of patients scanned each day. There clearly is an opportunity to improve the quality *and* number of MRI scans that can be run each day.
The Solution	Our solution is an image processing invention that reduces the scan time and allows for motion correction.
Key benefits	• Decreased MRI scan time • Motion correction • Artificial Intelligence based image processing • Post-processing - no interference with MRI software • Low-cost manufacturing
Development Stage	Validation
Brief Description & Differentiation	This invention increases throughput by solving the following two challenges: • Reduction of scan time, and • Reduction of motion artefacts. The technology is a machine learning based image processing method that solves the challenges outlined above. Specifically, Convolutional Neural Networks, also known as Deep Learning, are trained using a large number of MRI scans to solve the challenges. To reduce the scan time, our technology produces high quality images with a data volume acquired in a fraction of the standard scan time. This is achieved with a first Neural Network; a second Neural Network is trained to reconstruct images that are affected by motion artefacts, with impressive results (Figure 1).
Research Team	Led by Dr Kamlesh Pawar (Monash Biomedical Imaging).
Intellectual Property	Two PCT applications filed (2019).
Key Publications	1. Pawar K, Chen Z, Shah NJ, Egan GF. Suppressing motion artefacts in MRI using an Inception-ResNet network with motion simulation augmentation. NMR in Biomedicine. 2019 Dec 22:e4225. 2. Pawar K, Chen Z, Shah NJ, Egan GF. A Deep Learning Framework for Transforming Image Reconstruction Into Pixel Classification. IEEE Access. 2019 Dec 12;7:177690-702. 3. Pawar K, Chen Z, Shah N, Egan G. ReconNet: a deep learning framework for transforming image reconstruction into pixel classification. InProceedings of the 26th Annual Meeting of ISMRM, Paris, France 2018 (p. 0574). 4. Pawar K, Chen Z, Shah NJ, Egan GF, (2018) Motion Correction in MRI using Deep Convolutional Neural Network, Proc ISMRM Scientific Meeting and Exhibition 2018. 5. Pawar K, Chen Z, Shah NJ, Egan GF, (2018) MoCoNet: Motion Correction in 3D MPRAGE images using a Convolutional Neural Network Approach, arXiv 2018.

Video link: https://youtu.be/ms4ThzpFwEU

See over for Figures.

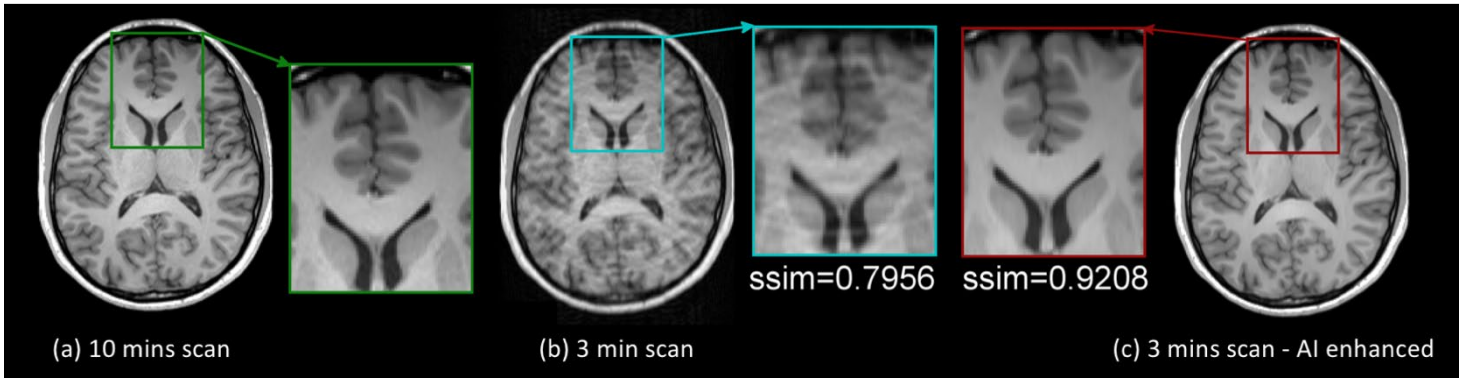

Figure 1: Scan time reduction results.

(a) An image reconstructed with 10 mins of scan;

(b) An image reconstructed with 3 mins of scan, resulting in poor quality with ringing artefact and blurring in the image

(c) A 3 min scanned image in (b) enhanced by the deep learning algorithm.

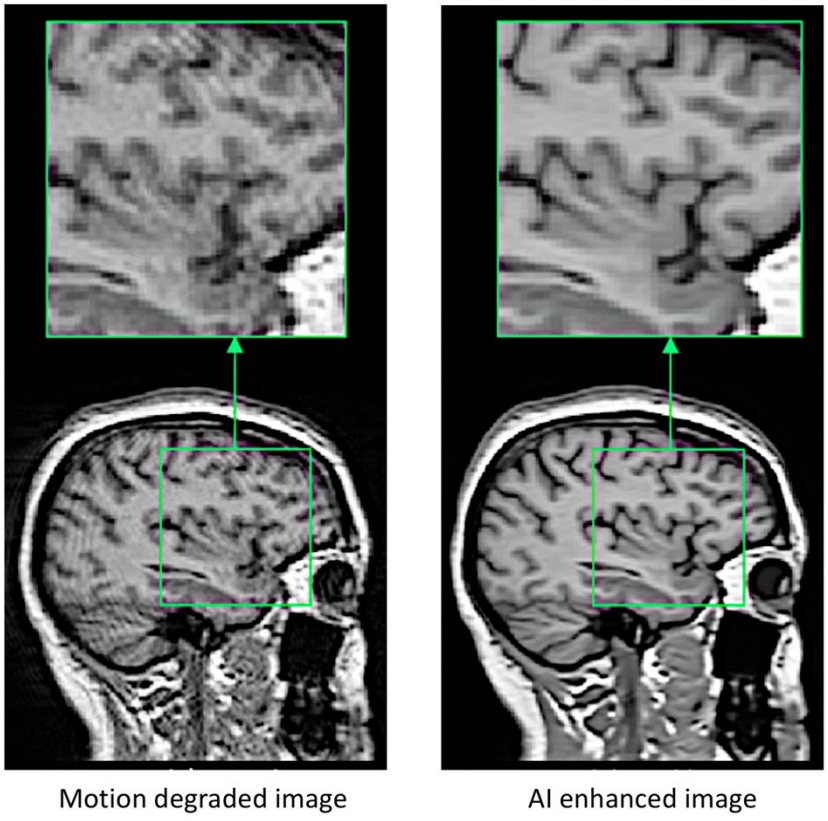

Figure 2: Left: Image degraded due to patient motion during the scan; **Right:** Image corrected to remove motion and restore the high-quality image.