Wales
Data Nation
Accelerator

Improving image quality and safety of ultra-high field magnetic resonance imaging with deep learning

Summary

The challenge

Ultrahigh-field (UHF) magnetic resonance imaging (MRI) yields superior diagnostic image quality. However, patient motion affects the sensitivity of the imaging equipment, and therefore, can affect the diagnostic images and readings. It is not possible to measure these effects.

The solution

We have developed a Deep Learning (i.e. Artificial Intelligence) method that can estimate the effect of patient motion on the sensitivity of the imaging hardware. A Conditional Generative Adversarial Network (CGAN) was trained on a simulated dataset of MRI images of up to 20 mm patient movement.

The networks reduced the worst-case motion-related error from 60% to 10%. In this project, we expanded our training dataset and retrained our networks, which has more than doubled the performance of our method, reducing the error further to 4% (Figure 1).

The outputs of the networks can be used to correct motion-related artefacts in diagnostic images, reducing the need for rescanning patients (Figure 2).

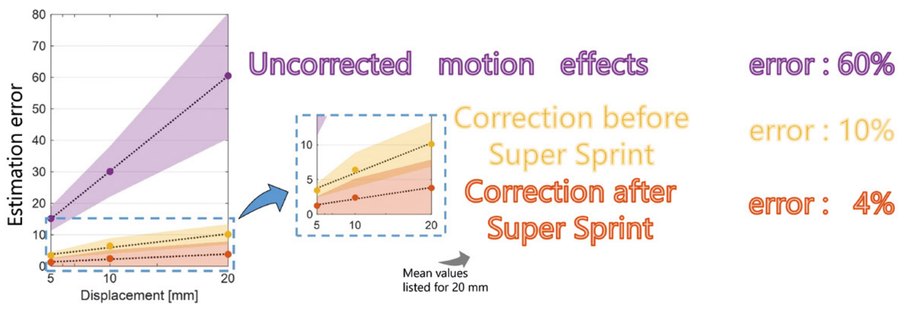

Figure 1: The effect of motion on sensitivity of imaging hardware was reduced from 60% to 4% using Deep Learning.

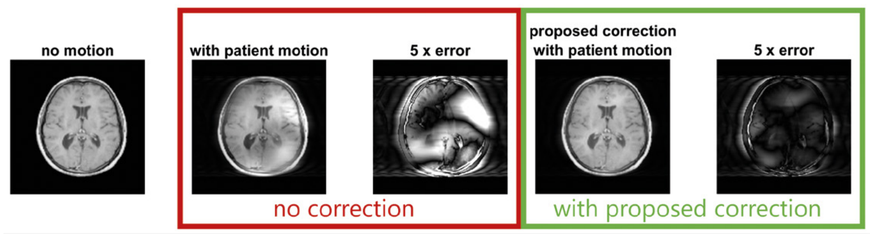

Figure 2: The effect of patient motion on sensitivity of imaging hardware manifests as artefacts in diagnostic images. The proposed method reduces motion-related artefacts.

Benefits

The proposed method makes it possible to correct the effects of patient motion on diagnostic imaging with UHF MRI scanners, which will:

- reduce the need to rescan patients,
- pave the way for high-quality imaging of paediatric patients and patients with tremors.

A larger and more representative training set was generated:

- method can be used for a wider patient cohort with better performance,
- performance of the method has more than doubled.

Further exploitation/next steps

Participant data acquired

- will test the method under realistic conditions.

Results show benefit of expanding dataset

- will further diversify the dataset to maximize performance,
- will publish a scientific publication to facilitate uptake by other MRI sites,
- will apply for funding to develop this method to investigate patient safety in the presence of motion.

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Project group

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