Researchers combine data science and machine learning techniques to improve traditional MRI image reconstruction

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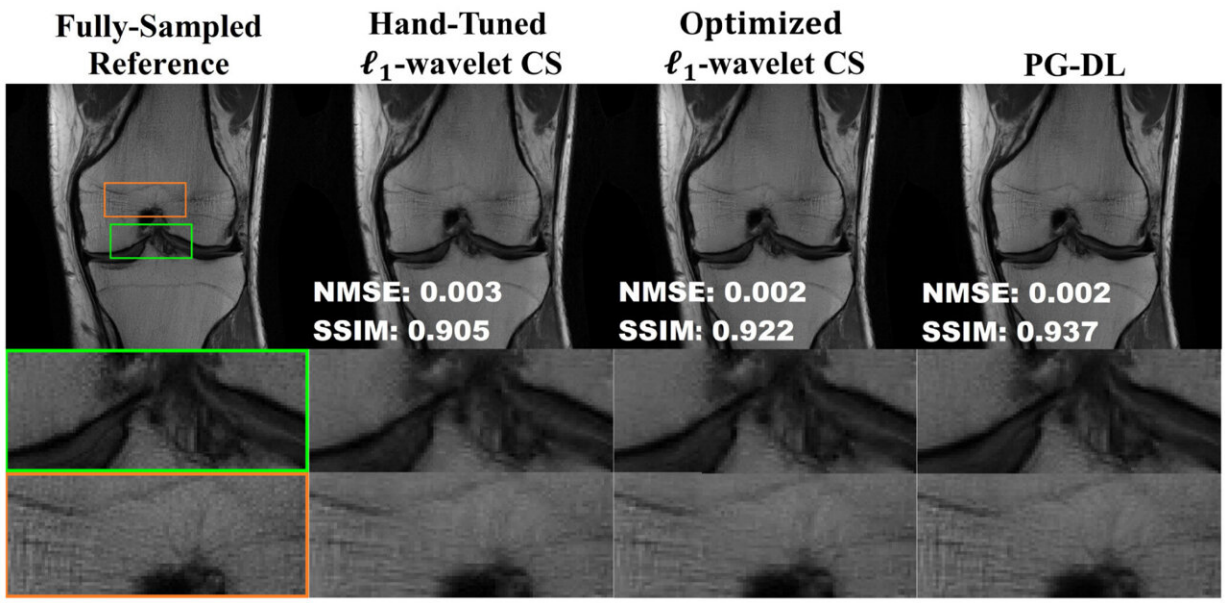

University of Minnesota Twin Cities researchers have found a way to improve the performance of traditional Magnetic Resonance Imaging (MRI) reconstruction techniques, allowing for faster MRIs without relying on the use of newer deep learning methods. Credit: Intelligent Medical Imaging and Image Processing Lab, University of Minnesota

University of Minnesota Twin Cities scientists and engineers have found a way to improve the performance of traditional Magnetic Resonance

Imaging (MRI) reconstruction techniques, allowing for faster MRIs to improve health care.

The paper is published in the *Proceedings of the National Academy of Sciences*.

"MRIs take a long time because you're acquiring the data in a sequential manner. You have to fill up the frequency space of your image in a successive manner," explained Mehmet Akcakaya, the Jim and Sara Anderson Associate Professor in the University of Minnesota Department of Electrical and Computer Engineering and senior author of the paper. "We want to make MRIs faster so that patients are there for shorter times and so that we can increase the efficiency in the health care system. This paper explores a way of doing this while making sure that we maintain a good performance."

For the last decade or so, scientists have been making MRIs faster using a technique called compressed sensing, which uses the idea that images can be compressed into smaller sizes, akin to zipping a .jpeg on a computer.

More recently, researchers have been looking into using deep learning, a type of machine learning, to speed up MRI image reconstruction. Instead of capturing every frequency during the MRI procedure, this process skips over frequencies and uses a trained machine learning algorithm to predict the results and fill in those gaps.

Many studies have shown deep learning to be better than traditional compressed sensing by a large margin. However, there are some concerns with using deep learning—for example, having insufficient training data could create a bias in the algorithm that might cause it to misinterpret the MRI results.

Using a combination of modern data science tools and machine learning ideas, the University of Minnesota Twin Cities researchers have found a way to fine-tune the traditional compressing method to make it nearly as high-quality as deep learning.

Akcakaya said this finding provides a new research direction for the field of MRI reconstruction.

"What we're saying is that there's a lot of hype surrounding deep learning in MRIs, but maybe that gap between new and traditional methods isn't as big as previously reported," Akcakaya said.

"We found that if you tune the classical methods, they can perform very well. So, maybe we should go back and look at the classical methods and see if we can get better results. There is a lot of great research surrounding deep learning as well, but we're trying to look at both sides of the picture to see where we can find the best performance, theoretical guarantees, and stability."

More information: Hongyi Gu et al, Revisiting $\ell 1$-wavelet compressed-sensing MRI in the era of deep learning, *Proceedings of the National Academy of Sciences* (2022). DOI: 10.1073/pnas.2201062119

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