How deep learning algorithms create accurate images without a complete dataset

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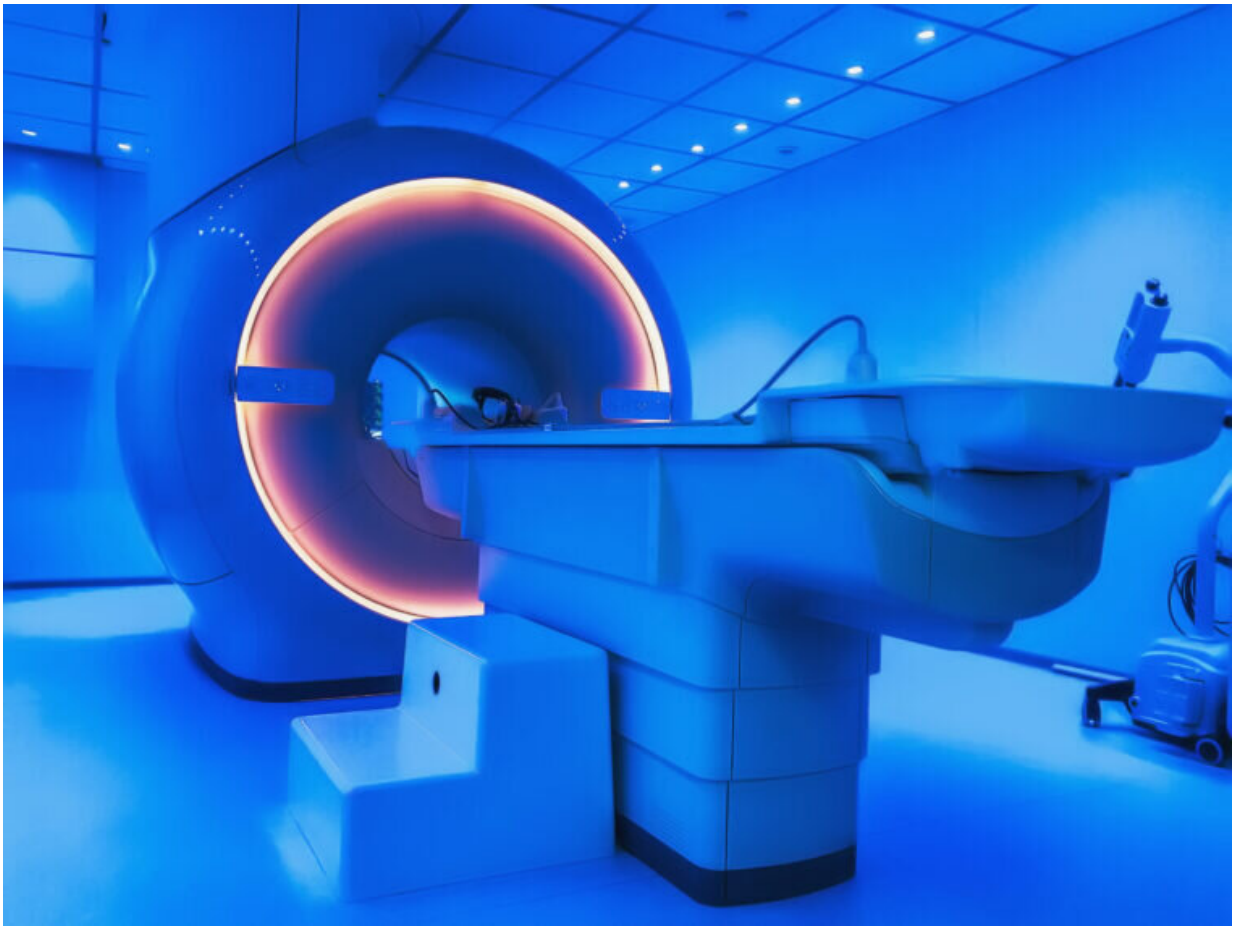

Ulugbek Kamilov, at the McKelvey School of Engineering at Washington University in St. Louis, and co-authors lay out a pathway to a clear theoretical framework for describing how deep neural networks remove the noise and visual artifacts to create accurate images without a complete dataset from technologies such as MRI machines. Credit: Shutterstock

The speed of data collection in many kinds of imaging technologies, including MRI, depends on the number of samples taken by the machine. When the number of collected samples is small, deep neural networks can be used to remove the resulting noise and visual artifacts.

The technology works, but there is no standard theoretical framework—no complete theory—to describe why it works.

In a paper presented at the NeurIPS conference in late 2021, Ulugbek Kamilov, at the McKelvey School of Engineering at Washington University in St. Louis, and co-authors laid out a pathway to a clear framework. Kamilov is an assistant professor in the Preston M. Green Department of Electrical & Systems Engineering and the Department of Computer Science & Engineering.

Kamilov's findings prove, with a few constraints, that an accurate image can be obtained by a deep neural network from very few samples if the image is of the type that can be represented by the network.

The finding is a starting point toward a robust understanding of why deep learning AI is able to produce accurate images, Kamilov said. It also has the potential to help determine the most efficient way to collect samples and still obtain an accurate image.

More information: Recovery Analysis for Plug-and-Play Priors using the Restricted Eigenvalue Condition. arXiv:2106.03668 [cs.CV] arxiv.org/abs/2106.03668

Provided by Washington University in St. Louis