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Fast MR Imaging: Signal Processing Meets Spin Physics

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Magnetic resonance imaging (MRI) has been a powerful tool in the fields of scientific research and clinical diagnosis. However, long scanning time is the bottleneck of MRI, which seriously restricts its widely clinical applications. Accelerating MR imaging has been an ongoing research topic since its invention in the 1970s. One way to reduce scan time is undersampling in k-space, which could result in artifacts in image if directly applying inverse FFT for undersampled k-space data. To solve this ill-posed inverse problem of image reconstruction, utilizing prior information is an important strategy. In this lecture, technologies for fast MR imaging will be surveyed from the perspective of signal processing, and the shortcomings of the current methods will be described and the corresponding countermeasures will be given. Specifically, model-driven deep learning methods combining the MR physical model with deep learning will be introduced, and it will be demonstrated how to unroll the iterations of a reconstruction process to a learnable deep network architecture. A general framework on model-driven deep learning will be explained to maximize the potential of deep learning and model-based reconstruction for fast MR imaging.

Keywords: Fast imaging, image reconstruction, deep learning, imaging model