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Super-resolution and Denoising of Flow MRI Data using Physics-Constrained Deep Learning LUNING SUN, JIAN-XUN WANG, University of Notre Dame — The recent advances in the flow magnetic resonance (MR) imaging enable *noninvasive* and *in vivo* measurement of the blood flow velocity field. However, the resolution and signal-to-noise ratio (SNR) of flow MR images still remain the limiting factors in clinical practice. This is especially true when investigating small vascular structures such as intracranial aneurysms or treating near-wall regions where wall shear stress is calculated. Therefore, super-resolution and denoising of flow fields from MR images are of great importance and remain active research areas. In this work, we propose an innovative deep learning framework to upscale low-resolution flow fields and to reduce the measurement noise using physics-constrained deep neural networks (DNN). Specifically, a generative DNN will be trained on the low-resolution data to capture the flow field. In the meantime, the violation of physical laws will be penalized on a large number of spatiotemporal points where measurements are not available and noises are expected to be reduced. The trained generative model can reconstruct the flow field with arbitrarily high resolution. Several test cases with synthetic vascular flow data are studied to demonstrate the merit of the proposed method.

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