

ARCSC-Net: An Approximate Residual Convolutional Sparse Coding Network For Compressed Sensing MRI

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INTRODUCTION

The model-based CS-MRI methods cannot meet the requirements of MRI reconstruction in both image quality and running speed.

The deep learning-based CS-MRI methods have a fast reconstruction speed but lack interpretation and overly dependent on the quantity and quality of training samples.

The algorithm unrolling technique can connect the traditional iterative optimization algorithm with the neural network structure, thereby building an efficient and interpretable iterative neural network.

METHODS

- Based on the iterative shrinkage-thresholding algorithm (ISTA) for the CSC problem, we propose an improved learning ISTA for CSC.
- Based on the proposed learning ISTA, we propose ARCSC-Net for CS-MRI.

Algorithm 1 Improved learning ISTA for CSC

Input: original signal x_0

Initialization: $D_e, D_d, D, z_0 = D_e^T x_0$

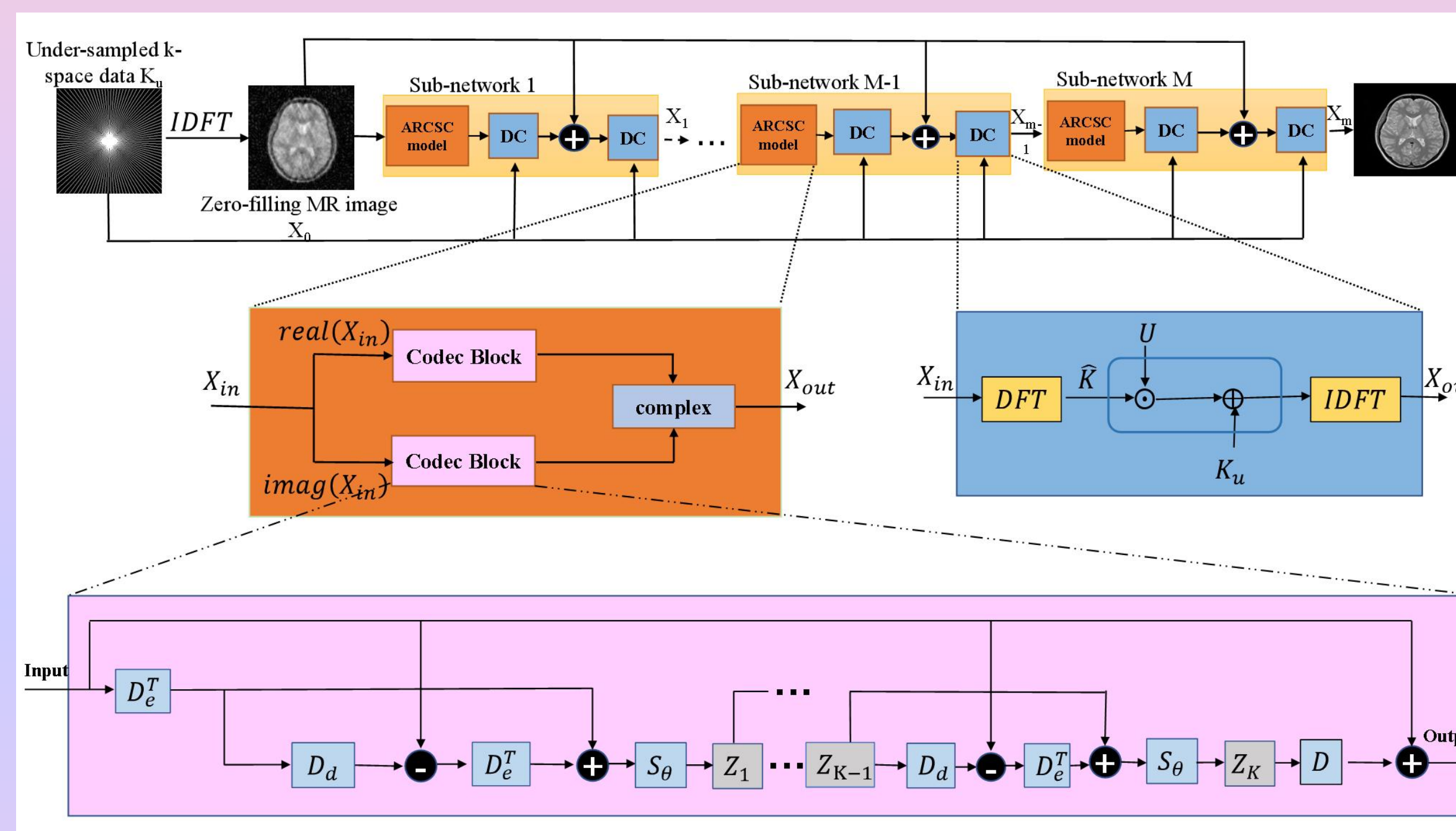
for iteration $k = 1:K$ **do**

Update z_k of the current iteration using $z_k = S_\theta(z_{k-1} + D_e^T(x_0 - D_d z_{k-1}))$, $k = 1, \dots, K$

end for

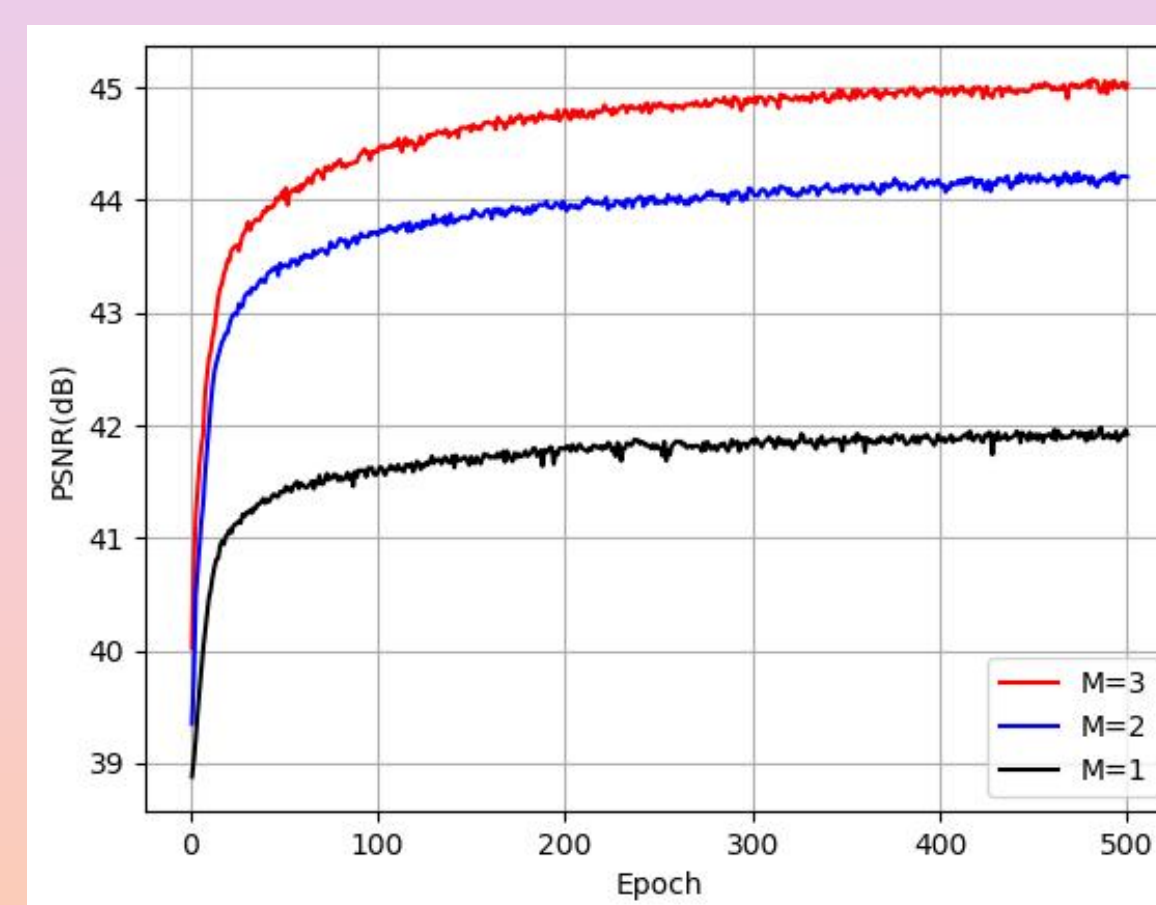
Reconstruct signal \hat{x} via $\hat{x} = D z_K + x_0$

Output: The final sparse coding z_K , the reconstructed signal \hat{x}

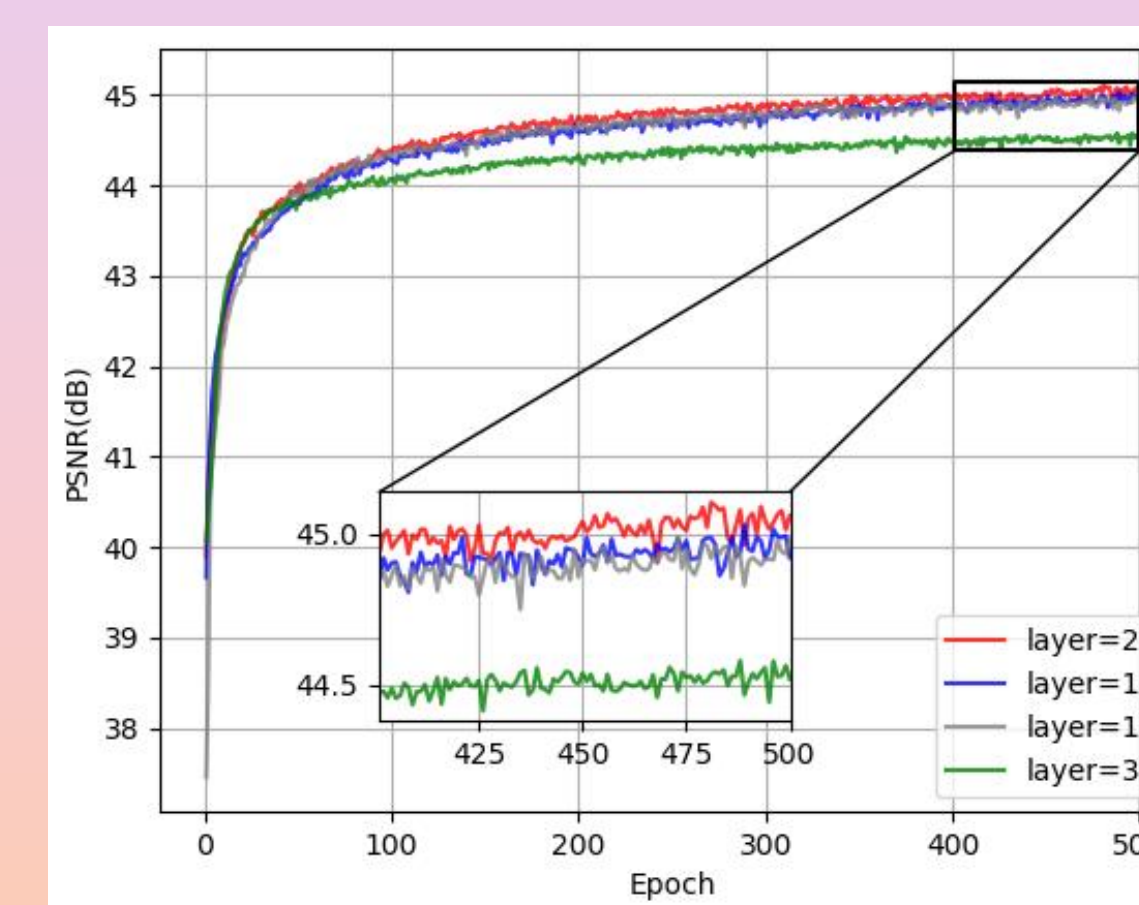


RESULTS

The impact of the number of sub-networks and the number of iteration layers

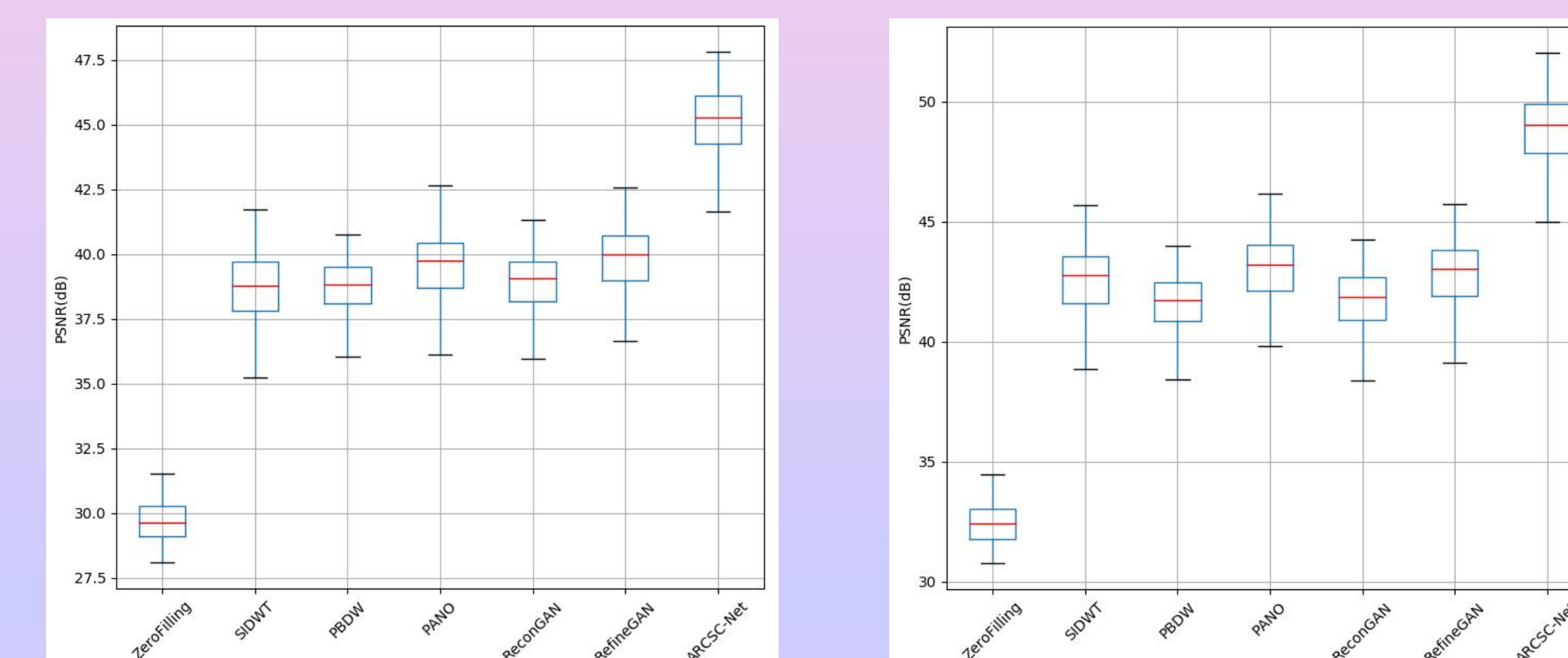


M vs PSNR

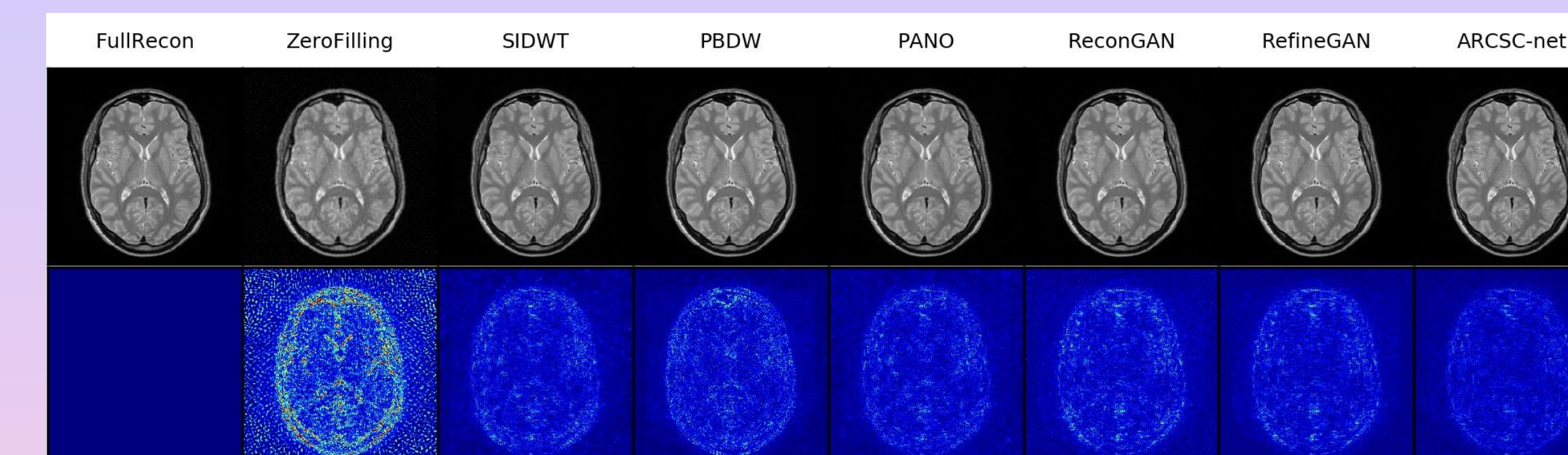


layer vs PSNR

Comparison with other advanced CS-MRI methods



PSNR evaluations on the brain test set with a sampling rate of 30% (left) and 40% (right).



Results on brain MR image using 40% pseudo radial sampling scheme.

CONCLUSION

Numerous experiments have shown that our proposed ARCSC-Net performs better in reconstruction speed, quantitative comparison and visual quality compared with the state-of-the-art CS-MRI methods.

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