Personalized Patient-adaptive Sparse-View CT Deep Reconstruction

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Motivation

There exists a lot of study on using deep learning that is trained on a large dataset to reconstruct medical images. However, deep-learning-based methods are susceptible to bias, instability and unknown data distributional shift, which causes difficulties in tuning the model to a specific patient or generalizing to unseen patients.

New Technique

- We propose a a novel corrector algorithm using neural representation learning (Residual-NeRP Ensemble) to correct the outputs from an existing deep learning model
- We propose a novel residual ensemble technique that further improve the image reconstruction performance
- We provide theoretical analysis of the optimal parameters of residual ensemble
- We performed extensive experiments with different data modalities and various and noise levels to demonstrate the effectiveness of our method

Related Work

- Sparse-Gen (2017)
- Image Adaptive GAN (2020)
- Implicit Neural Representations with Periodic Activation Functions (2020)
- NeRP (2021)
- DL-PICCS (2021)

References

[1] Zhang, C., Li, Y., & Chen, G. H. (2021). Accurate and robust sparse-view angle CT image reconstruction using deep learning and prior image constrained compressed sensing (DL-PICCS). Medical Physics, 48(10), 5765-5781.
[2] Shen, L., Pauly, J., & Xing, L. (2021). NeRP: Implicit Neural Representation Learning with Prior Embedding for Sparsely Sampled Image Reconstruction. arXiv preprint arXiv:2108.10991.

Experimental Results

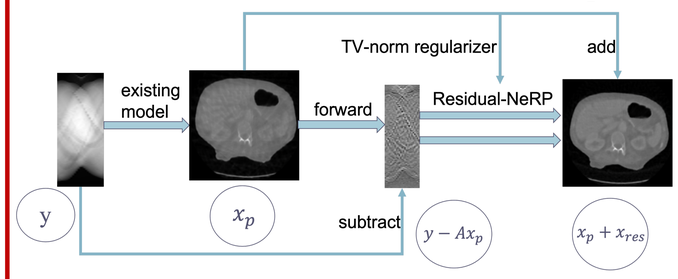

Table 1: Results

Method	Abdominal		Head		Chest	
	PSNR	SSIM	PSNR	SSIM	PSNR	SSIM
FBP-Conv	32.78	0.938	31.91	0.919	29.78	0.885
+BP	32.28	0.918	31.76	0.919	30.30	0.888
+ADMM	32.84	0.942	33.40	0.945	29.67	0.892
+PICCS	34.70	0.959	35.44	0.964	31.12	0.913
Ours	**35.75**	**0.968**	**36.85**	**0.969**	**31.54**	**0.920**