Memory-efficient Learning for High-dimensional MRI Reconstruction

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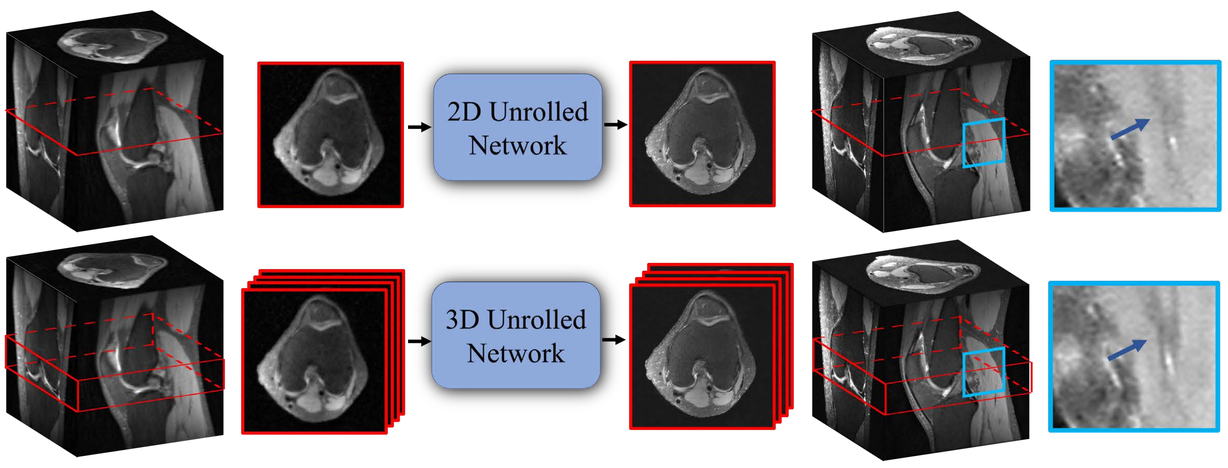
Overview

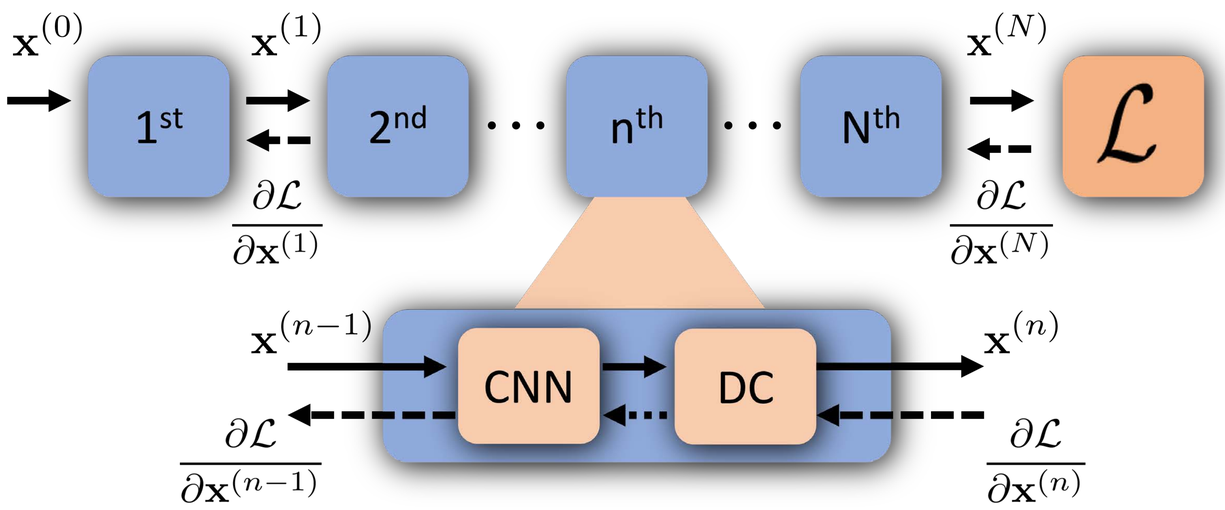
- High-dimensional MRI reconstruction is often **limited by the GPU memory capacity**.
- We enables it with a **memory-efficient learning (MEL) framework**.

Theory about Memory-efficient Learning

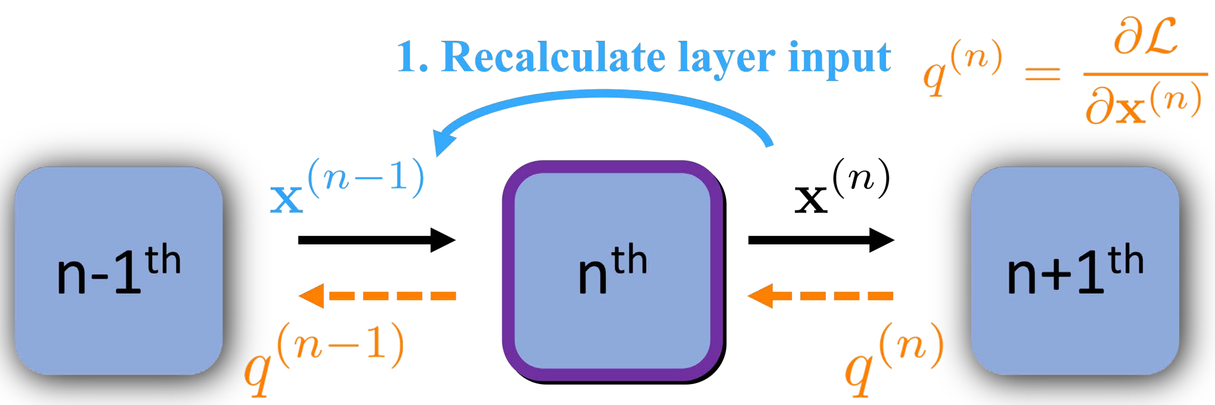
High dimensional DL recon: from 2D to 3D



- Deep Learning (DL) reconstructions leverage high-dimensional data prior.

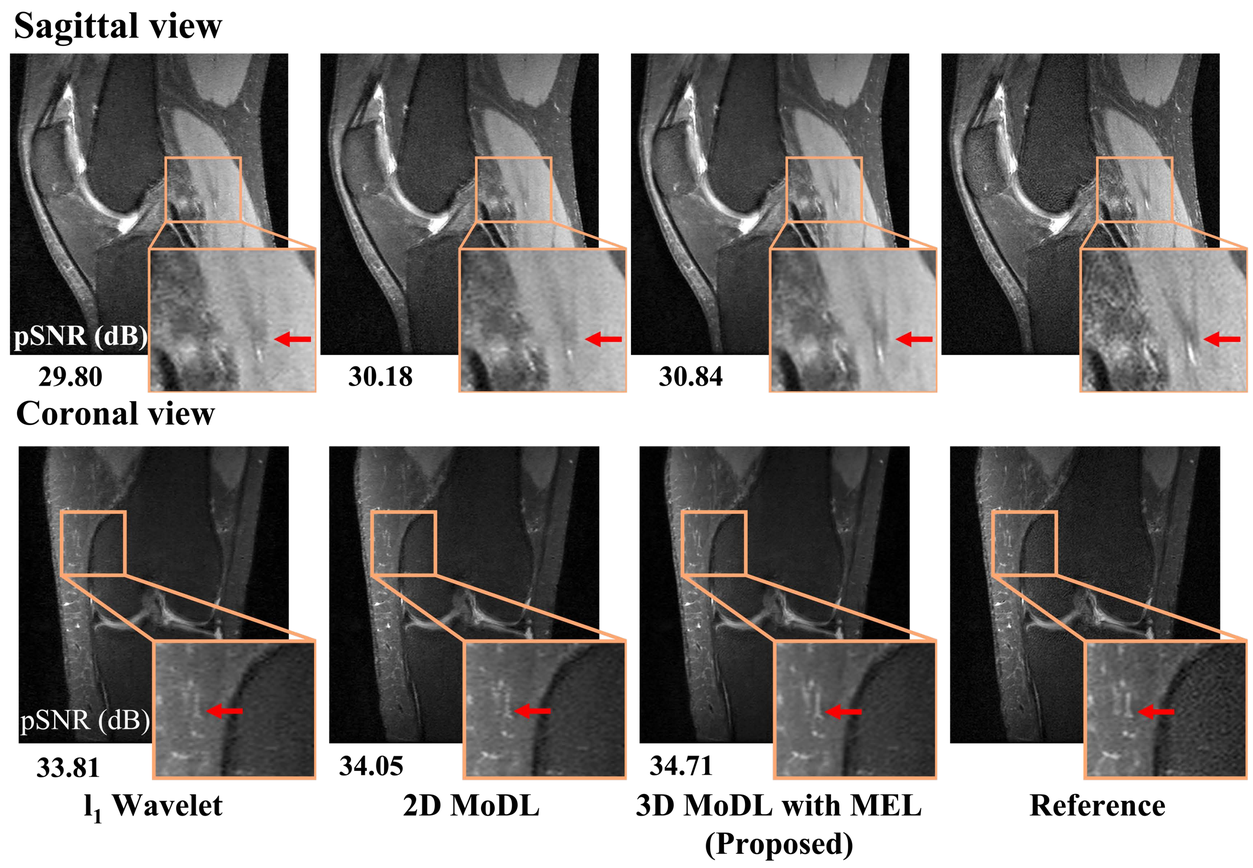


- Existing methods: gradient is computed for the entire computational graph.



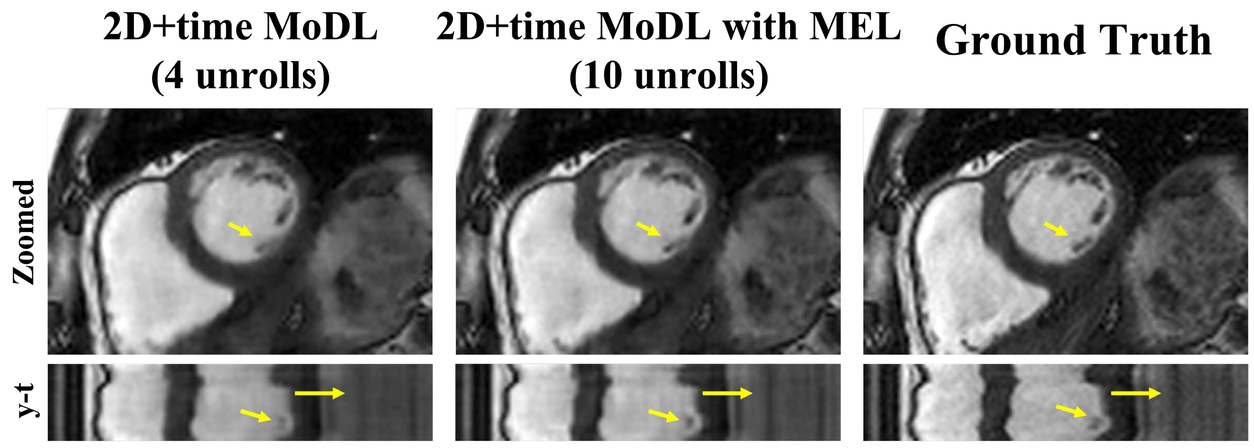
- Our MEL: Backpropagate through one layer at a time.

Results on 3D Multi-channel MRI



- We use MoDL as DL reconstruction framework.
- MEL requires **11 GB** instead of usual **40+ GB**.
- MoDL with MEL has a higher PSNR, improved perceptual image quality and texture continuity.

Results on 2D+time Cardiac Cine MRI



- MEL enables training 2D+time Cardiac Cine MRI reconstruction with larger number of unrolls, requiring only **3.4 GB** instead of **20+ GB**.
- 2D+time MoDL with MEL has higher PSNR/SSIM and improved motion profile.

References

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- [2] Aggarwal, H.K., Mani, M.P., Jacob, M.: Modl: Model-based deep learning architec-ture for inverse problems. IEEE transactions on medical imaging, 2018.
- [3] Hammernik, K., Klatzer, T., Kobler, E., Recht, M.P., Sodickson, D.K., Pock, T.,Knoll, F.: Learning a variational network for reconstruction of accelerated mridata. Magnetic resonance in medicine, 2018.