Accelerated Reconstruction

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- Purpose:
- To demonstrate accurate MR image reconstruction from undersampled k-space data using **cross-domain** convolutional neural networks (CNNs).
- The network architecture operating on k-space, image, k-space, and image sequentially

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- Cross-domain CNNs consist of 3 components:

1. KCNN - a deep CNN operating on the k-space (as Raki)
2. ICNN - a deep CNN operating on an image domain (as Unet)
3. IDC - Interleaved data consistency operations

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Problem Formulation

- Problem formulation

$$\arg\min_{wi,wk} \left|\left| Im - ICNN\left(F^{-1}\left(KCNN(\downarrow k)\right)\right)\right|\right|^2 +$$

$$\lambda \,||\downarrow k - \downarrow F(ICNN(F^{-1}\left(KCNN(\downarrow k)\right))||^2$$

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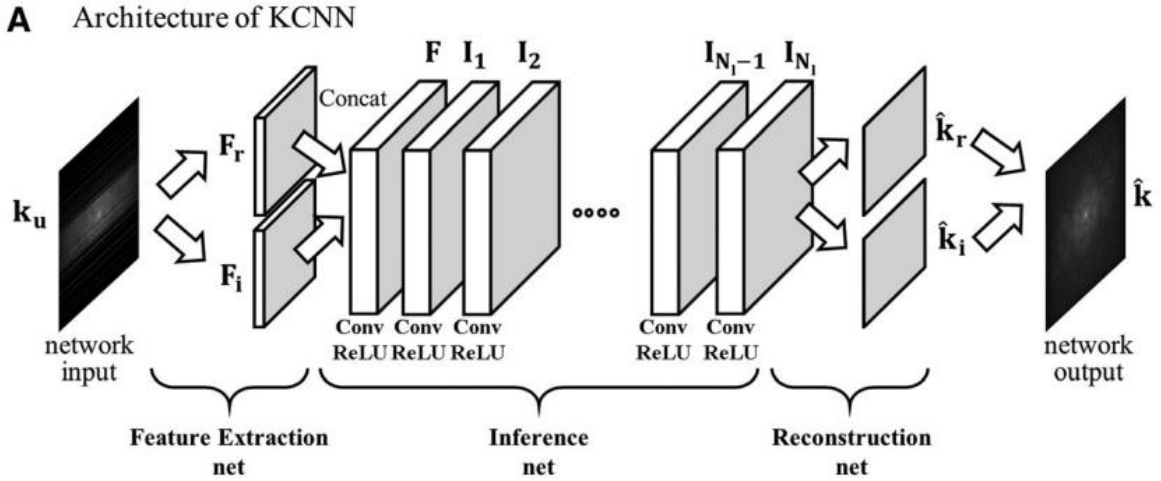
KIKI Architecture

- KCNN

  Deep CNN for k–space completion



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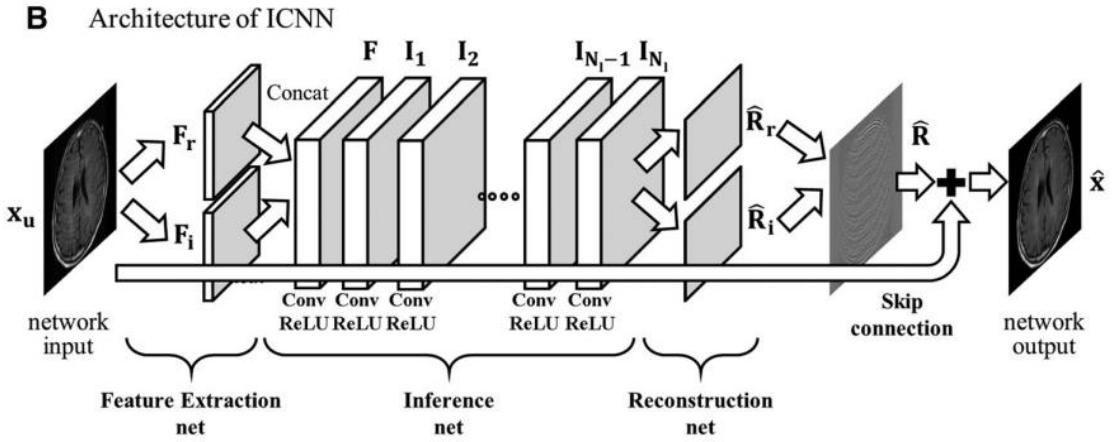
KIKI Architecture

- ICNN

  Deep CNN for image restoration



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KIKI Architecture

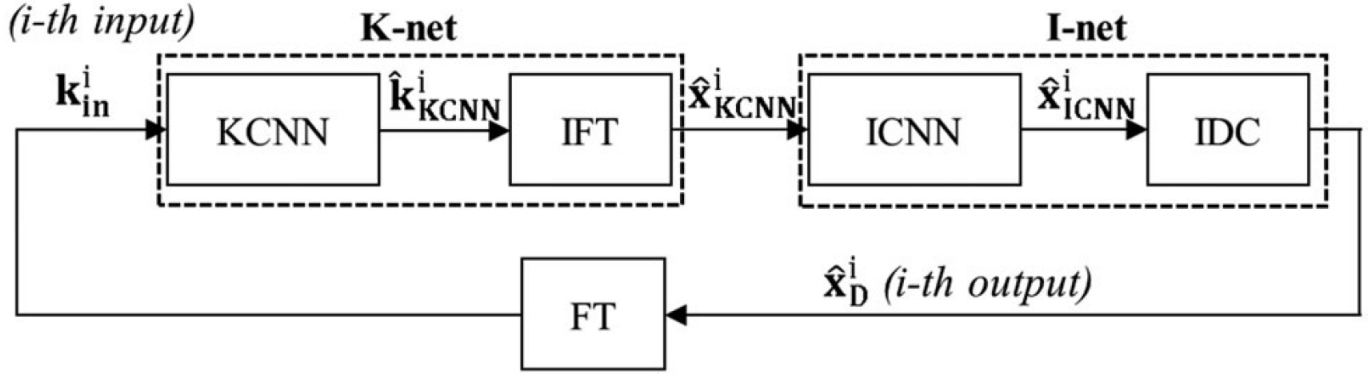

FIGURE 2 Block diagram for data flow and intermediate operations of cross-domain CNNs (CD-CNNs)

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Dataset - fastMRI

- Facebook, NYU, UFlorida
- An Open Dataset and Benchmarks for Accelerated MRI
- A large-scale collection of both raw MR measurements and clinical MR images, that can be used for training and evaluation of machine-learning approaches to MR image reconstruction

NYU Langone Health

facebook AI Research

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fastMRI

- Goal
  - make rapid advances in the state of the art for MR image reconstruction

- Single – Coil track: knee only
  - Center cropped to 256X256
  - Raw knee space

- Image normalize to range 0-1

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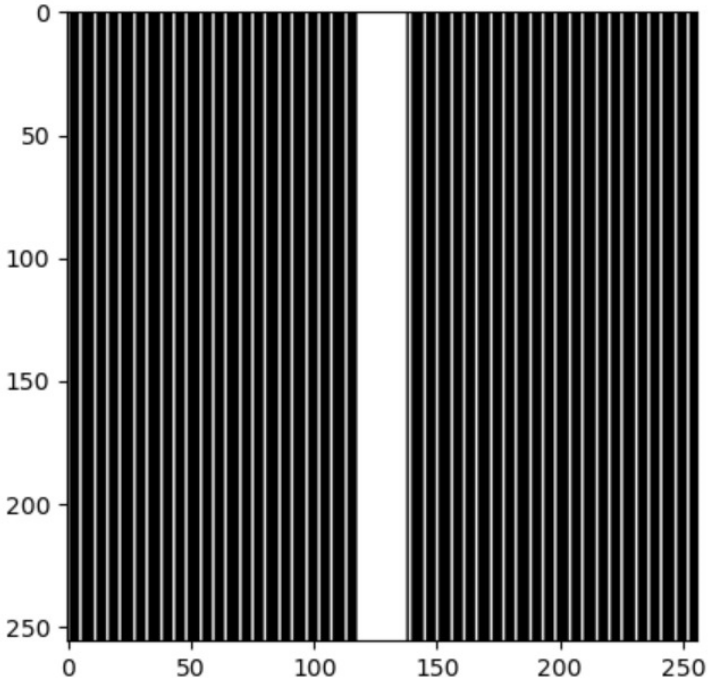
Undersampling mask



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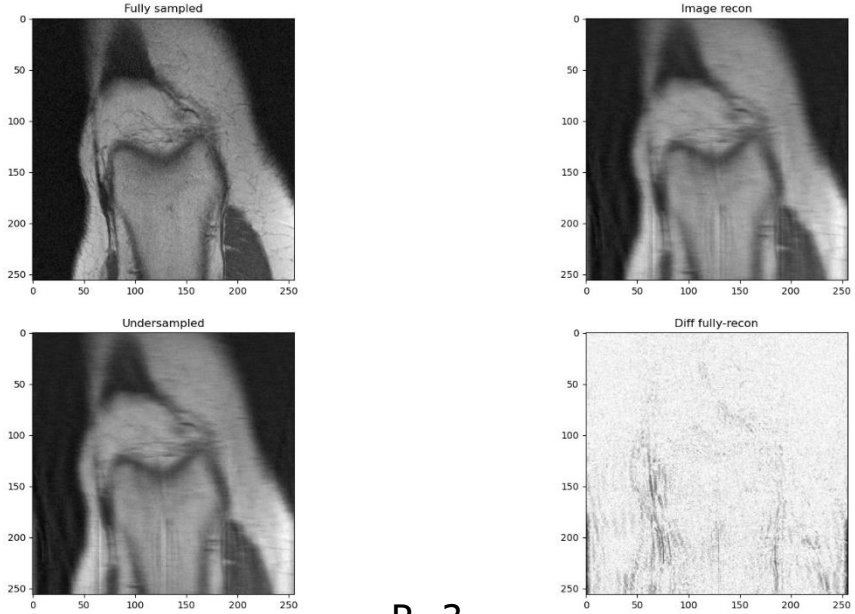
Results



R=3

MSE = 0.002602 NMSE = 0.007142

PSNR = 28.28 SSIM = 0.6785

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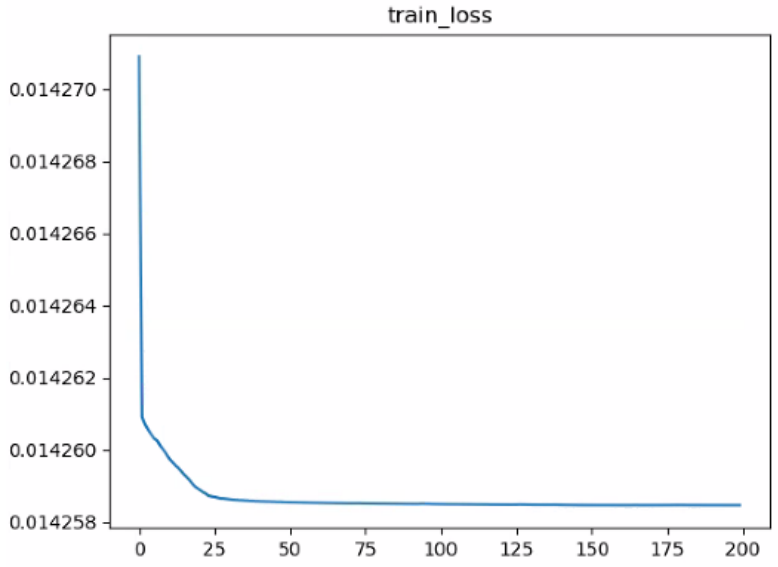
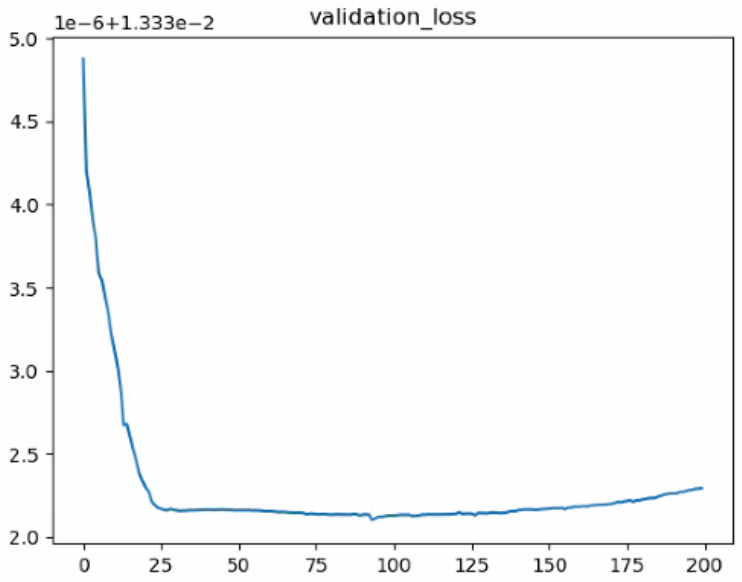
Results





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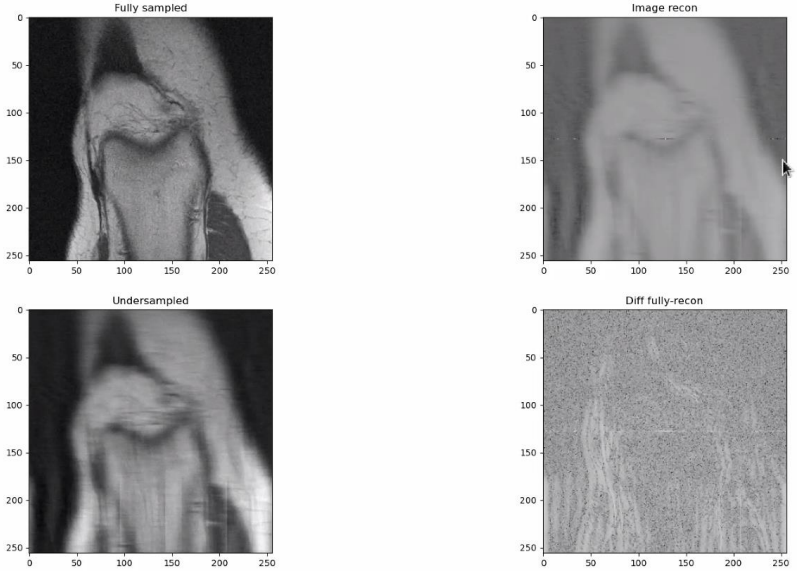
Experiment 2 - adding skip connection to K-net



R=4

MSE = 0.003901 NMSE = 0.01071

PSNR = 26.53 SSIM = 0.6079

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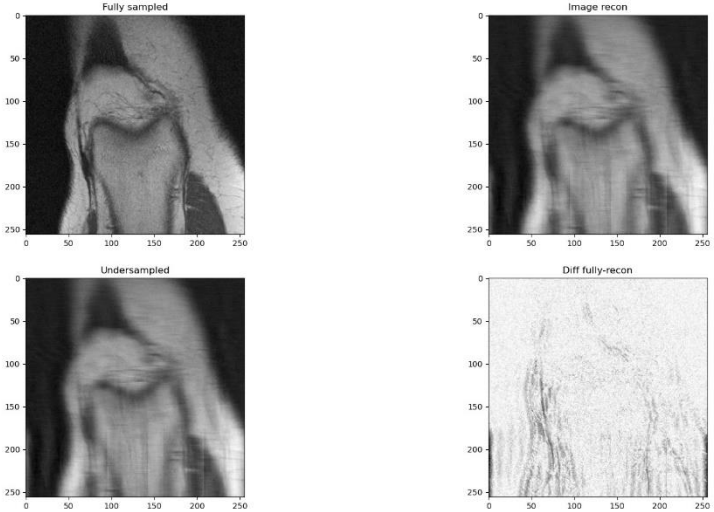
Experiment 3 – 35 layers



R=4

MSE = 0.003256 NMSE = 0.008937

PSNR = 27.31 SSIM = 0.6125

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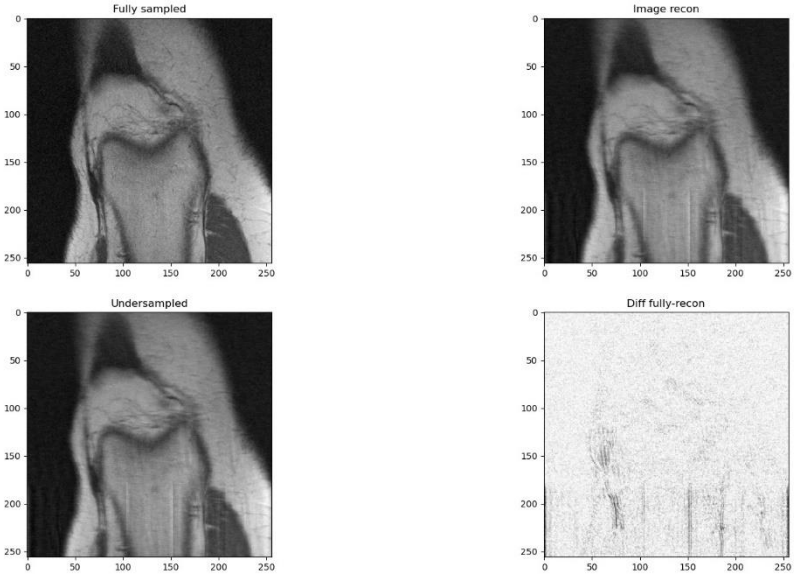
Experiment 4 – Huber loss



R=2

MSE = 0.001747 NMSE = 0.004796

PSNR = 30.01 SSIM = 0.7858

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Summary and conclusion

Conclusion

- Noisy data
- Pre processing of the data
- Data consist term

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Thanks for listening!

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