MULTI-SCALE DEEP COMPRESSIVE SENSING NETWORK

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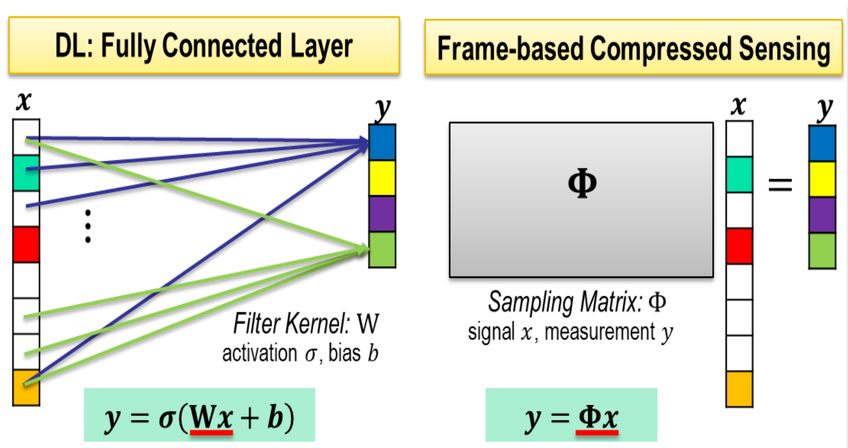
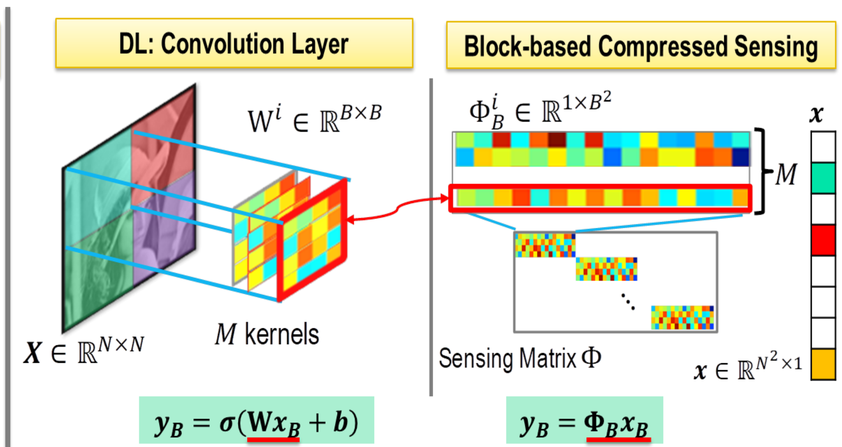
1. Abstract

- Deep Compressive Sensing (DCS)[1] enables non-iterative reconstruction
- Previous work focus on single scale compressive sampling[1].
- This paper is the first attempt to explore multi-scale sampling and recovery in DCS
- Multi-phase training is adopted to boost the performance

2. Compressive Sensing meets Deep Learning



- High complexity for high dimension signal

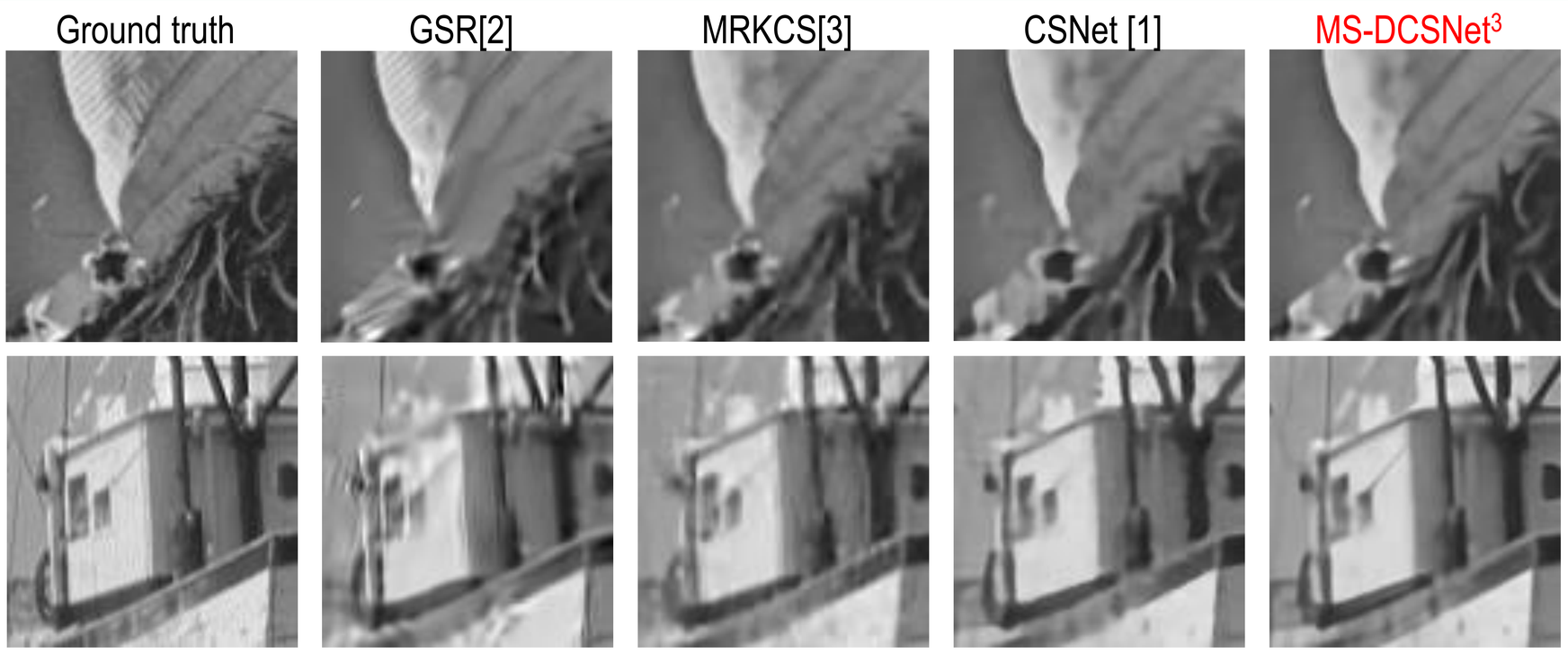


- Low complexity, efficient training (*preferred*)

3. Related Work

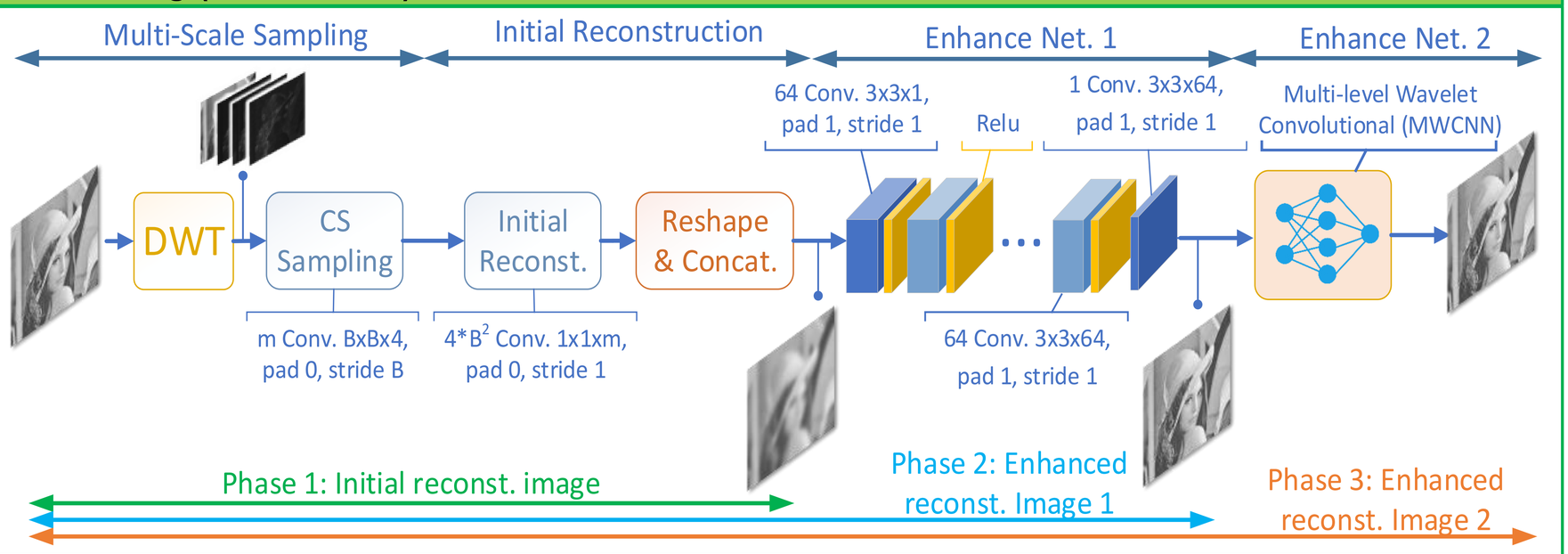
- Learned matrix (CSNet) captures low-frequency more and lead to loss of high frequency
- Similar to multi-scale sampling (MRKCS), CSNet produces higher quality than single scale
- Prior information[4] (wavelet decomposition) has been utilized in deep learning for reconstruction

→ *Guide the network to capture signal in multi-scale better!*



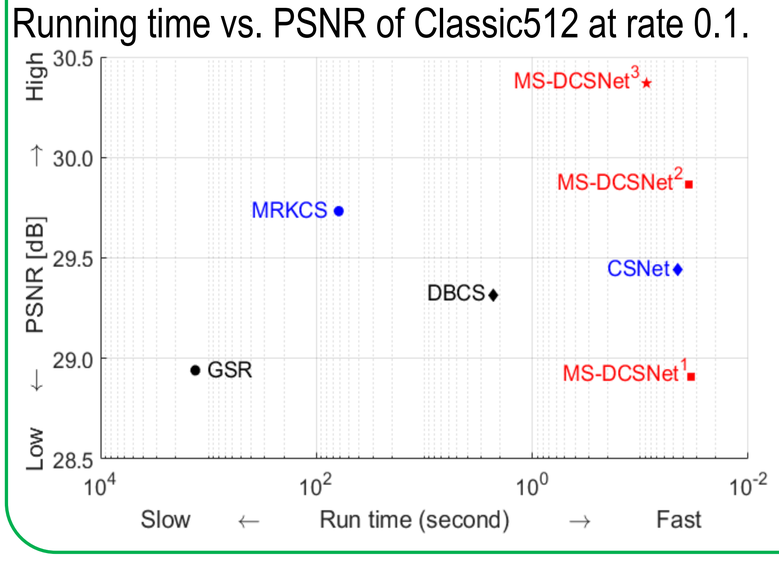
5. Proposed Multi-Scale Deep compressive Sensing (MS-DCSNet)

- Learn to adaptive sampling at different wavelet sub-band
- Consist of multi-scale sampling, initial and two enhance reconstruction networks (with MWCNN[4])
- Multi-Phase training: three phases of sequential training
- Loss function Euclidean loss



6. Experimental Results

Running time vs. PSNR of Classic512 at rate 0.1.



Average PSNR [dB] & SSIM values by various algorithms on Set5 and Set14

Image	Rate	GSR [2]		CSNet [3]		MS-DCSNet1		MS-DCSNet2		MS-DCSNet3	
		PSNR	*SSIM*	*PSNR*	*SSIM*	*PSNR*	*SSIM*	*PSNR*	*SSIM*	*PSNR*	*SSIM*
Set5	0.1	29.98	0.866	32.30	0.902	30.66	0.855	32.44	0.904	**33.39**	**0.917**
	0.2	34.17	0.926	35.63	0.945	34.06	0.924	35.82	0.947	**36.56**	**0.951**
	0.3	36.38	0.949	37.90	0.963	36.51	0.952	38.20	0.965	**38.74**	**0.967**
Set14	0.1	27.51	0.771	28.91	0.812	27.81	0.778	29.10	0.815	**29.67**	**0.828**
	0.2	31.20	0.865	31.86	0.891	30.69	0.874	32.05	0.893	**32.51**	**0.900**
	0.3	33.71	0.907	33.99	0.928	32.86	0.917	34.30	0.930	**34.71**	**0.934**

MS-DCS^k is MS-DCS after training phase k-th

6.Conclusion

- We joint learn the multi-scale sampling and the multi-scale reconstruction based on multi-level wavelet convolution
- MS-DCSNet can capture signal at multiple scale with better performance than the single scale sampling CSNet

[1] S. Wuzhen et al., "Deep network for compressed image sensing," *ICME*, 2017.
[2] J. Zhang et al., "Group-based spare representation for image restoration," T-IP, 2014.
[3] T. N. Canh et al., "Multi-scale/Multi-resolution Kronecker CS," IEEE ICIP, 2015.
[4] P. Liu et al., "Multi-level Wavelet-CNN for Image Restoration," CVPRW, 2018.

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The source code is available at github.com/AtenaKid/MS-DCSNet-Release.