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Image Compressed Sensing Using Auxiliary Information for Efficient Coding

Bo Zhang*, Di Xiao+, and Dongjing Shan*
*Army Engineering University, + Chongqing University

Bo Zhang(张波)
Army Engineering University

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Part 1 **CS Background**

$$\boldsymbol{y} = \boldsymbol{\Phi x}$$

$\boldsymbol{y} \in R^M$

The measurement vector

$\boldsymbol{\Phi} \in R^{M \times N} (M = \quad N)$

The measurement matrix

$\boldsymbol{x} \in R^N$

The original signal

Since M is far less than N, y can be regarded as a compression version of x.

$$\mathbf{y} = \boldsymbol{\Phi}\mathbf{x}$$

$\boldsymbol{y} \in R^{M}$

The measurement vector.

$\boldsymbol{\Phi} \in R^{M \times N} (M = \ \ N)$

The measurement matrix

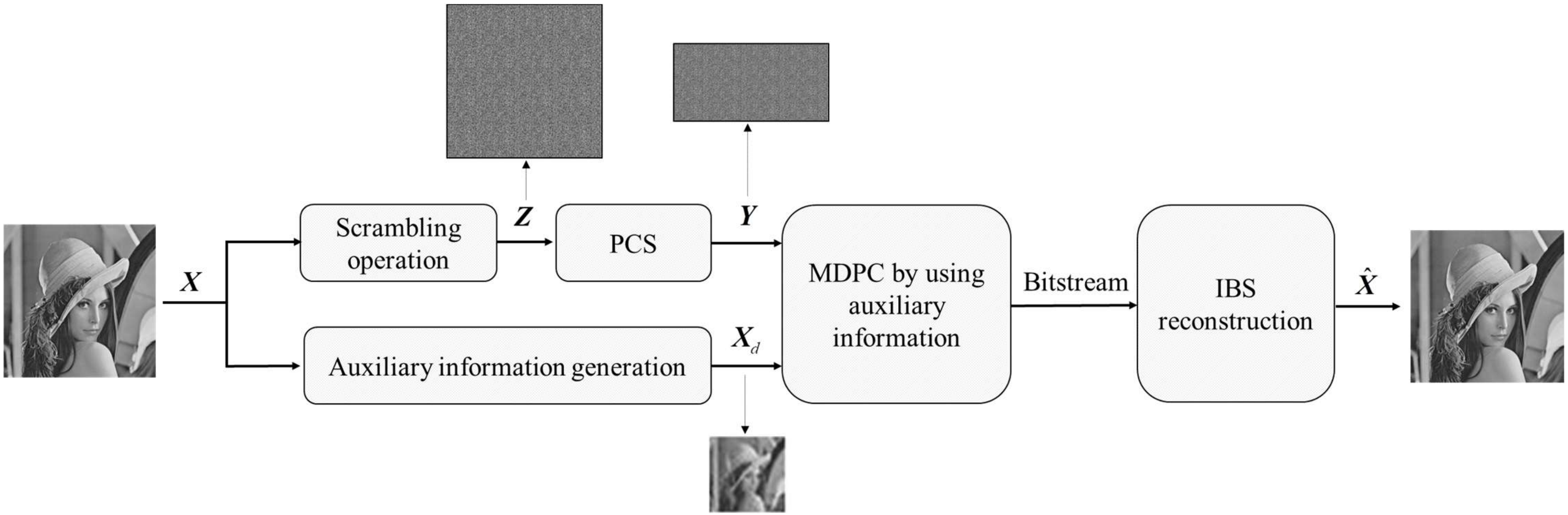
$\boldsymbol{x} \in R^{N}$

The original signal

Hence, an efficient coding algorithm for CS samples is desirable.

- Part 2 **The proposed method**

2.1 Overview



PCS： parallel compressed sensing

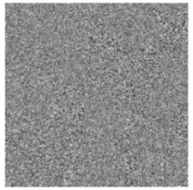
MDPC：measurement-domain prediction coding

IBS：iterative bivariate shrinkage

2.2 Image scrambling

The original image

$\boldsymbol{X}$ → **Scrambling** → $\boldsymbol{Z}$



The scrambled image

$$\boldsymbol{Z} = \mathrm{E}(\boldsymbol{X})$$

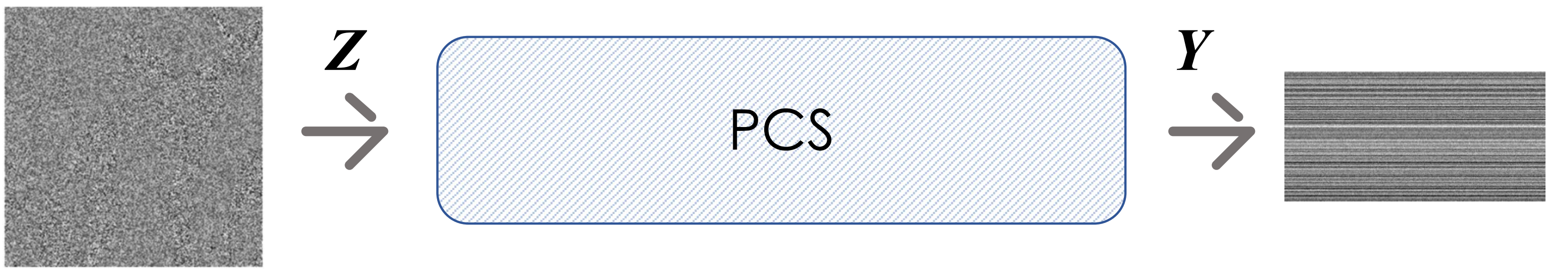
$\boldsymbol{Z} \in R^{N \times N}$

The scrambled image

$\mathrm{E}(\bullet)$

The scrambling operation

2.3 Compress the scrambled image by using parallel CS (PCS).



The scrambled image

The CS samples

$$Y = \Phi Z$$

$Y \in R^{M\times N}$

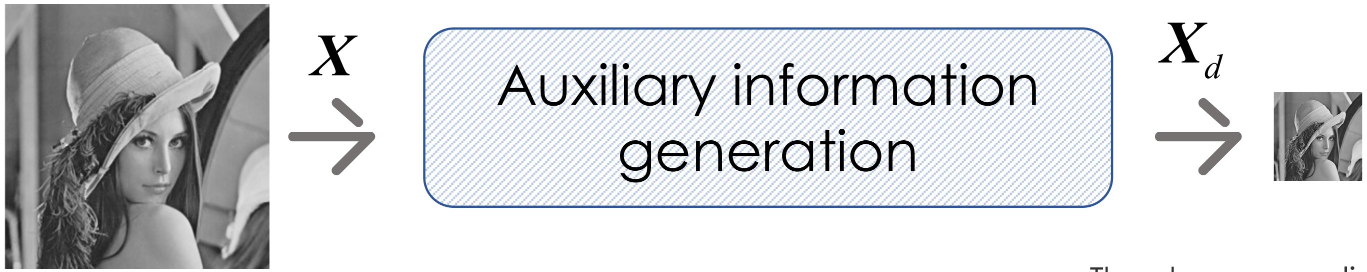
The CS samples

$\Phi \in R^{M\times N}(M = \; N)$

The measurement matrix

2.4 Measurement-domain prediction coding

Step 1: Generate the auxiliary information

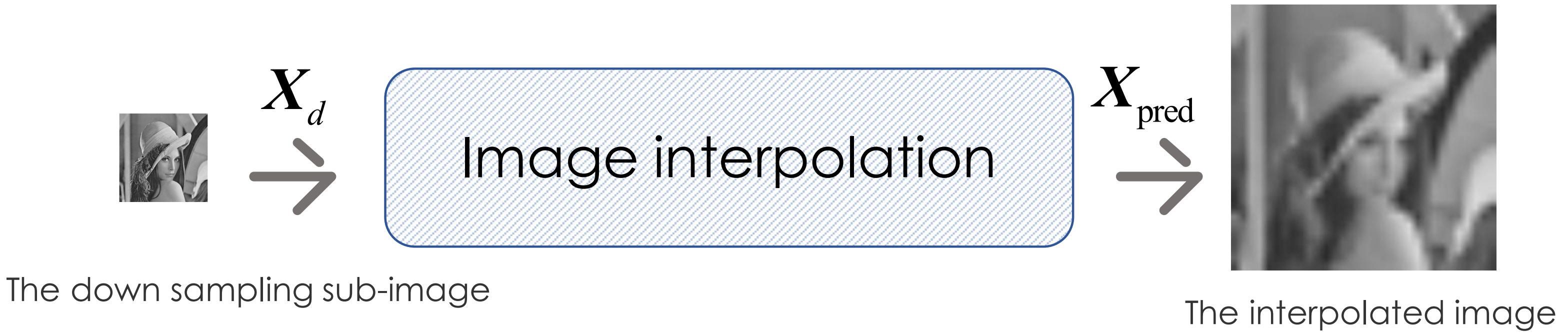


The down sampling sub-image

The original image

2.4 Measurement-domain prediction coding

Step 2: Generate an interpolated image



2.4 Measurement-domain prediction coding

Step 3: Measurement prediction.

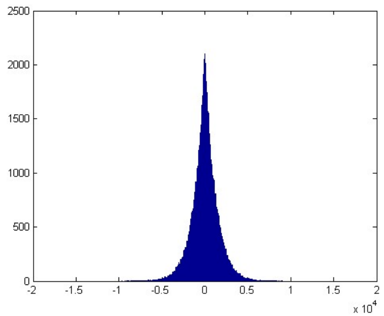
$$\boldsymbol{Y}_{\text{pred}} = \boldsymbol{\Phi}\,\mathrm{E}(\boldsymbol{X}_{\text{pred}})$$

$$\boldsymbol{Y}_{\text{pred}} \in R^{M \times N}$$

The predicted CS samples

2.4 Measurement-domain prediction coding

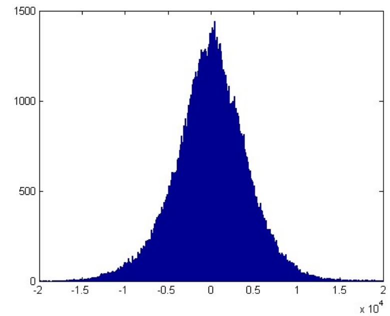
Step 4: Calculate the residuals.



$$\boldsymbol{Y}_{\mathrm{e}} = \boldsymbol{Y} - \boldsymbol{Y}_{\mathrm{pred}}$$

$$\boldsymbol{Y}_{\mathrm{e}} \in R^{M \times N}$$

The residuals



- Part 3 **Simulations results**

Compression performance evaluation

Table 2: Comparison of PSNR (in dB) for the five tested schemes.

Images	Schemes	bpp				
		1.0	1.5	2.0	2.5	3.0
Lena	BCS-DPCM	27.23	29.35	30.93	32.71	34.04
	SPCS-GT	29.85	32.56	35.22	36.33	36.89
	SPCS-MDPC	**33.09**	**36.00**	**38.92**	**40.85**	**42.26**
	SBCS	27.90	29.06	31.35	32.80	34.57
	2DCS	31.34	33.33	35.77	37.48	39.07
Barbara	BCS-DPCM	23.83	24.92	26.29	27.37	28.83
	SPCS-GT	27.22	31.23	33.42	35.13	35.82
	SPCS-MDPC	**31.01**	**33.92**	**36.65**	**38.74**	**40.41**
	SBCS	24.32	25.09	26.79	28.43	29.91
	2DCS	27.02	28.61	31.47	33.75	35.65

The proposed scheme has better compression performance than the previous schemes.

- Part 4 **Conclusions**

The main contribution of this paper is: we propose an image CS scheme by using auxiliary information to improve the R-D performance.

Thank you !