

Computational imaging: foundation, reality, and prospect

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I. INTRODUCTION

1. Computational Imaging (CI)

Although its applicability remains an evident issue, computational imaging (ref [1]), or formerly “compressed sensing,” has aroused the fantasy of scientists worldwide: the initial paper (ref [2]) has been cited over 37,000 times in only 20 years (2006 - 2026); the initial authors have reaped many prestigious honors including Gauss Prize 2018 and IEEE Kilby Medal 2021; it is being taught as a separate course in many universities, including Stanford University, MIT, University of Toronto, etc.; and it remains a main theme of IEEE conferences (CVPR, ICIP, ICASSP, ...) and journals (PAMI, TIP, TSP, Access, ...); despite the intense contentions over its mathematical correctness, and over the authenticity of its technical claims.

2. Maximum Accuracy Computing (MAC)

Maximum Accuracy Computing is our new mathematical theory and method for data prediction (extrapolation, interpolation, approximation, or reconstruction). It purports to predict unknown elements of a data set, given a portion of data samples, always attaining the maximum accuracy that the data samples can provide. Compared with the computational imaging method of Convolutional Neural Networks (CNN), MAC yields 40 times more accurate data: $\text{mse}(\text{CNN}) = \text{mse}(\text{MAC}) \times 40.18$ (mse: mean squared error), leaping from utterly inapplicable to perceptually identical, equivalent to the speed change **from horse wagon to jet engine**, i.e., from 15 mph to 600 mph, manifesting that MAC far surpasses CNN in capacity to learn complex data patterns.

Demo software, demo video, mathematical rationale, method description, and testing data are all downloadable at our website <https://www.lucidsee.ca>.

II. TECHNICAL COMPARISON

3. Comparison in perceptual quality

Figure 1 illustrates the comparison in perceptual quality between computational imaging (CI) and Maximum Accuracy Computing (MAC), where the results of CI are released by Rice University DSP Lab, in the name of “single-pixel camera” (ref [3]). The CI results are obtained from 40% data samples, while the MAC results are only from 25% data samples. In addition, MAC runs hundreds of thousands times faster than CI in computation.

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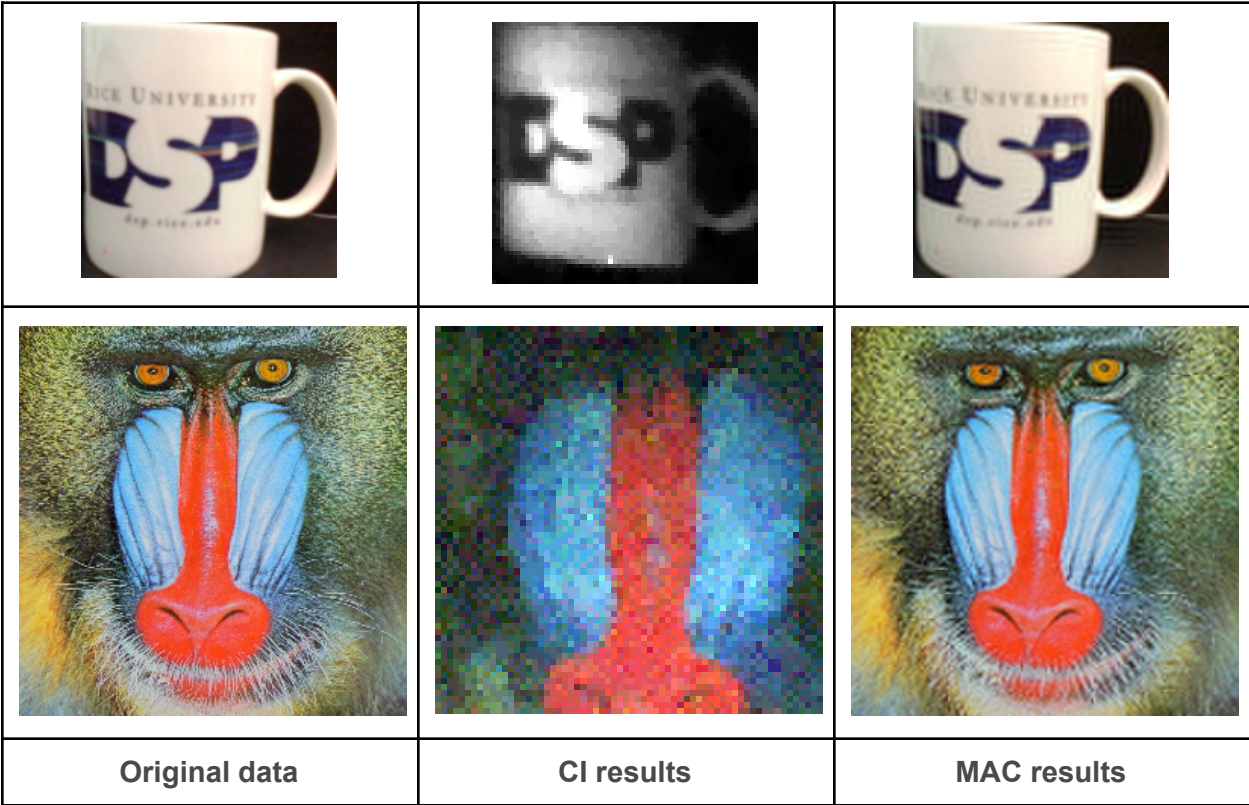


Figure 1 Computational imaging (CI) vs Maximum Accuracy Computing (MAC)

4. Comparison in numerical quality

Table 1 reports the comparison between MAC and the computational imaging method of Convolutional Neural Networks (CNN) in terms of PSNR (peak signal noise ratio, dB). The CNN results are provided in the CVPR paper (ref [4]). Notably, MAC attains 42.58dB in predicting Lena from 25% samples, in stark contrast to the 26.54dB by CNN. The leap of 16 dB in PSNR implies that $mse(CNN) = 40.18 \times mse(MAC)$. It is 40 times more accurate data, equivalent to the speed change **from horse wagon to jet engine**, i.e., from 15 mph to 600 mph, leaping from utterly inapplicable to perceptually identical.

	Lena	Birds	Fingerprint	MRI
MAC results	42.58	35.65	36.40	43.90
CNN results	26.54	23.23	25.57	—

Table 1 Convolutional Neural Networks (CNN) vs Maximum Accuracy Computing (MAC)

III. FACTS OF COMPUTATIONAL IMAGING

5. Reality (1): utterly inapplicable

For the visual quality and applicability of the images at 26dB or less, refer to the CI results in Figure 1, examples of severely distorted data, utterly inapplicable for any applications: the drastic distortions starkly disprove any brazen claim of their applicability, which is tantamount to the claim of capability to weave beautiful but invisible cloth.

6. Reality (2): without reproducibility

So far, most publications on computational imaging failed to present experimental results in all the due terms of actual image, PSNR, and running time. Even worse, although utterly inapplicable, those experimental results are not supported by verifiable software applications. For example, the most famous research product on computational imaging, Rice University's "single-pixel camera" (ref 3) is not supported by any downloadable software ever since, but is still crowned with the IEEE Best Paper Award 2020, signifying it remains the state of the art, although its paper was published in 2008, and even after its website was entirely removed around 2018, which should have rendered the paper retracted instead.

7. False mathematical foundation

Though the foundational paper (ref [2]) has been cited nearly 40,000 times, its main theorems are barely referred to in the literature. Those theorems seek to address the optimization problem in l_p norm, but only for $0 < p \leq 1$. In engineering, l_2 norm is more popular and practical. For example, MSE, PSNR, and SSIM are all expressed in terms of l_2 norm.

Even worse, the main theorems claim that random sampling is optimal or nearly optimal for the l_1 -minimization problem, riveting the ensuing research torrent on random sampling, false and absurd. It is well known that, it is the equiangular tight frames with minimal coherence, not the random sampling systems, that constitute the optimal case for the l_1 -minimization problems. On the contrary, random sampling prohibits the resultant system matrix from being equiangular, and hence always precludes the optimal results in practice.

In particular, it is the varying pattern, not the data values, that express the essential information of a deterministic data set such as a signal or an image. Therefore, data samples need to represent the structural pattern of a full data set as accurately as possible, in order to predict or reconstruct the full data set from those samples as accurately as possible. It takes no insight, just by common sense, to know that random sampling unavoidably distorts the data pattern into unpredictable, disparate, and chaotic information. This self-inflicted sabotage always engenders unpredictable, inapplicable, and hence the worst results in minimum accuracy, and can never be optimal at all. It is so blatantly absurd.

IV. CONCLUSION

Exploiting mass ignorance, absurdity may often produce popularity, but can never provide applicability. In reality, computational imaging is utterly inapplicable, and without reproducibility, solely because its mathematical foundation is false and absurd. As it turns out, the beauty of computational imaging is only audible, not visible: everybody says, but nobody sees, repeating the whole story of Emperor's New Clothes from beginning to end, including the final episode that the Emperor proceeds with his nude procession despite a child's revelation of his nudity, and as a result the swindlers continue to profit from their fraud. Unfortunately, no matter how long his procession takes, and no matter how many efforts his people pay, the Emperor's inherent nudity has no prospect of mutating into beautiful clothes.

REFERENCE

- [1]. <https://www.nature.com/nature-index/topics/l3/computational-imaging>
- [2]. David Donoho, "Compressed sensing," IEEE Transactions on Information Theory, April 2006
- [3]. Richard Baraniuk, *et al.*, "Single-pixel imaging via compressive sampling," IEEE Signal Processing Magazine, March 2008
- [4]. K. Kulkarni, *et al.*, "Reconnect: Non-iterative reconstruction of images from compressively sensed measurements," IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016