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Compressive Sensing Enhanced by Machine Learning

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We present our work on the using of machine learning to enhance the reconstruction quality of multimode fiber (MMF) based compressive sensing system [1]. MMF represents the ultimate limit in miniaturization of imaging endoscopes [2,3]. However, the spatial resolution and acquisition speed are usually limited in this system [4]. With a data-driven machine learning framework, we can solve both the problems. We implement a generative adversarial network (GAN) to explore the sparsity inherent to the model. This gives the possibility to provide compressive reconstruction images that are not sparse in a representation basis. The proposed method exceeds other widespread compressive imaging algorithms in terms of both image quality and noise robustness. We also experimentally demonstrate GAN enhanced ghost imaging below the diffraction limit at a sub-Nyquist speed through a thin MMF probe. The following Fig. 1 illustrates the idea of how to using GAN to improve the reconstruction quality of the compressive sensing problem. While Fig 1(a) shows the simple setup and Fig 1(b) shows the calculation theory, Fig 1(c) give the examples of the comparison of GAN reconstruction with other traditional sparsity based algorithms, where GAN shows clear advantage. Meanwhile, we also discuss the noise robustness of the methods by introducing artificial noise to both the measurement matrix and the measured signal, where GAN also shows superior behavior. Due to its potential in applications in various fields ranging from biomedical imaging to remote sensing, this method is of great significance.

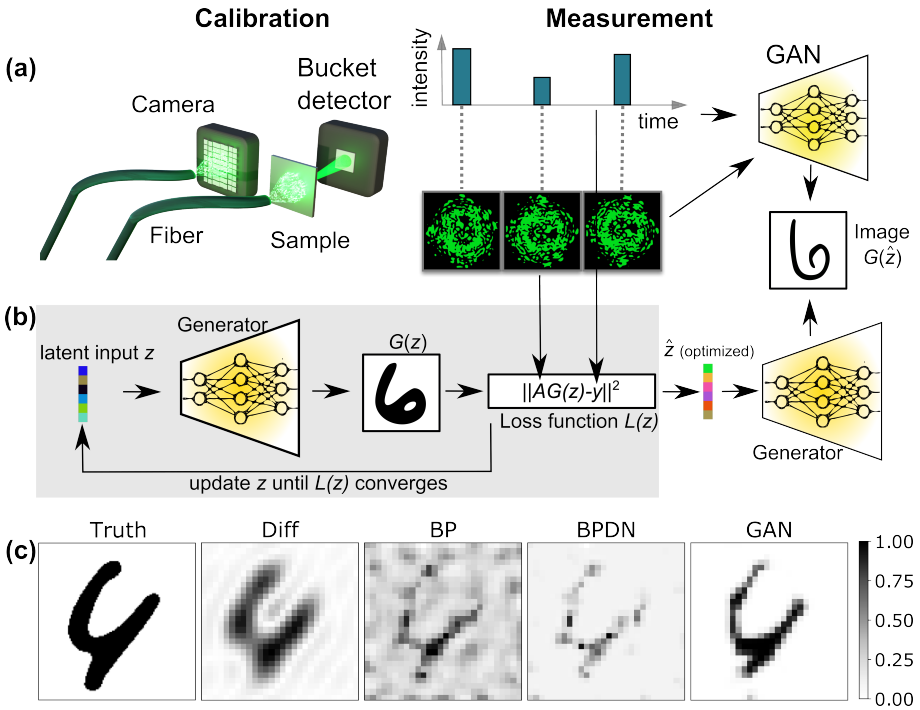

Fig. 1 Illustration of the idea of using GAN to improve the reconstruction of compressive imaging system. (a) shows the simple experimental setup. (b) shows the theory of the reconstruction process using GAN. (c) shows the examples of reconstruction comparison with other methods.

Example References

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