Single Pixel Imaging with a High-Frame-Rate LED Array

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Abstract
This paper describes a ghost imaging by use of an array of LED lights. Single pixel imaging is a method to obtain image by use of modulated illuminations and a point detector. We show possibility of single pixel imaging with spatio-temporally modulated LED array.

1. Introduction

Single pixel imaging, which is sometimes called ghost imaging, is a technique to obtain image by use of a single-pixel detector [1-3]. With single pixel imaging, the shape of a sample is reconstructed by measuring the light intensity with a bucket detector that collect all light transmitted through or scattered on the sample and correlating the illumination pattern and the measured light intensity. Our final goal is to realize single-pixel imaging for human detection without camera in corporate with a high-frame-rate LED array. Because LED lights, including LED lightings, can be modulated at an extremely high frame rate so that modulated patterns are unnoticeable for viewers. This paper proposes spatio-temporal codes and report simulated results on single-pixel imaging with the developed codes.

2. Principle

Fig. 1 and Fig. 2 show the principle of single pixel imaging. Light from a random pattern illuminates a sample. Then, the part of light that was not blocked by the sample is collected with a lens and detected with a bucket detector. The acquired data is substituted into the following formula to derive the correlation function.

$$\mathrm{G}(x,y,n) = \langle I_1(x,y,n) I_2(n) \rangle - \langle I_1(x,y,n) \rangle \langle I_2(n) \rangle$$

Then, the image output by applying a correction the value of the correlation function to minimum value equals 0 and maximum equals 1

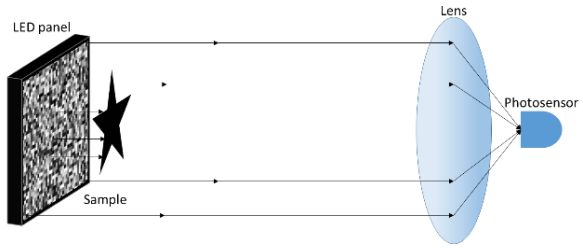

Fig. 1 Conceptual diagram of an ideal optical system for a single pixel imaging scheme.

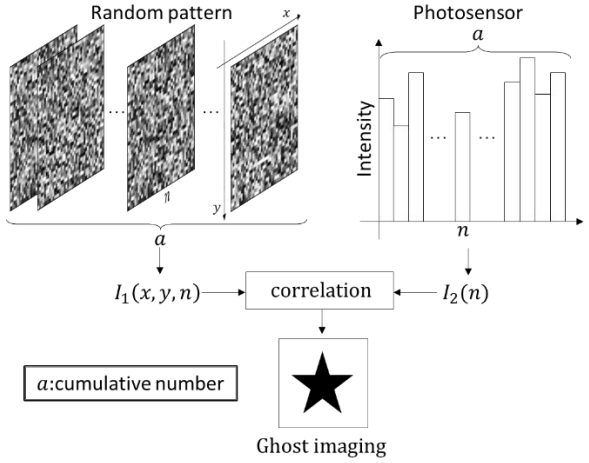

Fig. 2 Schematic diagram showing process to correlate the sensor outputs with random patterns to obtain image.

3. Result

Fig. 3 shows simulated results. A sample that was used is shown in the left. The parameter "a" means cumulated number. The results show the shape of the sample becomes clear as "a" is increased.

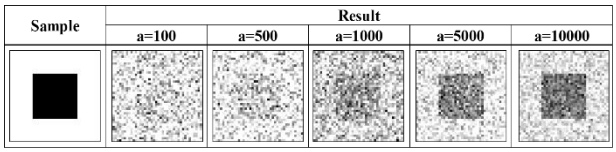

Fig. 3 Reconstructed results by use of simple random patterns

4. Conclusion

We have developed spatio-temporal codes for a high-frame-rate LED array so that random patterns are unnoticeable for viewers and the developed codes are applied single pixel imaging.

References

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