RECONSTRUCTION OF POLARIZATION IMAGES FROM A MULTIMOD LIGHT FIELD CAMERA BASED ON THE ALIASING MODEL

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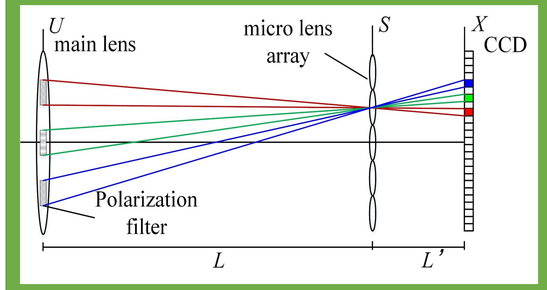
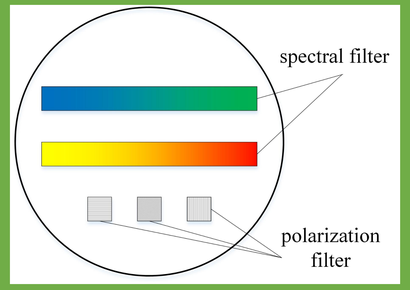
ABSTRACT
The multimode light field camera can capture the information of spatial location, spectral and polarization characteristics of target simultaneously. There is aliasing effect of the captured image which will cause that the directly extracted image from a certain filter includes information from other filters. In order to solve this problem, a new reconstruction method for reconstructing polarization images from the captured light field image is proposed along with an aliasing model.

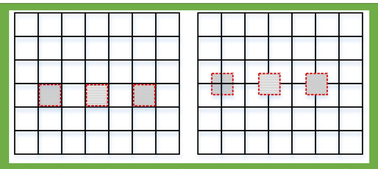
KEY POINT



a simple polarization imaging system based on light field



the filters on the main lens



ideal and actual imaging result

demonstration of aliasing by experiment

$$\begin{bmatrix} I_1 \\ I_2 \\ \vdots \\ I_t \end{bmatrix} = \begin{bmatrix} K_{s1,1} & \cdots & K_{s1,m} & K_{p1,1} & \cdots & K_{p1,n} \\ K_{s2,1} & \cdots & K_{s2,m} & K_{p2,1} & \cdots & K_{p2,n} \\ \vdots & \ddots & \vdots & \vdots & \ddots & \vdots \\ K_{st,1} & \cdots & K_{st,m} & K_{pt,1} & \cdots & K_{pt,n} \end{bmatrix} \cdot \begin{bmatrix} I_{s1} \\ \vdots \\ I_{sm} \\ I_{p1} \\ \vdots \\ I_{pn} \end{bmatrix}$$

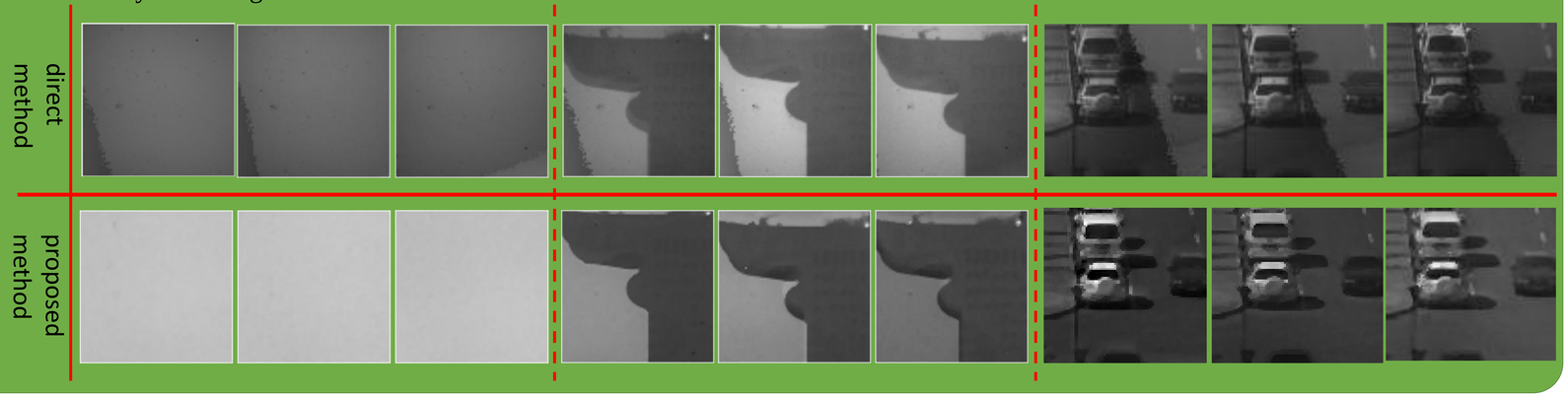
$$\sum_{i=1}^{t} K_{si,j} = 1 (j = 1,2,\cdots,m+n), K_{si,j} > 0$$

$$\sum_{i=1}^{t} K_{pi,j} = 1 (j = 1,2,\cdots,m+n), K_{pi,j} > 0$$

aliasing model of imaging system

EXPERIMENT AND RESULT
The light field image is a 900 × 900 pixel area. The polarization images extracted by directly extracting method are darker than those reconstructed by proposed method. The images should have uniform gray values because the target is a uniform area light. However, there are obvious brightness variation in the directly extracted polarization images. The reason is light from a polarization filter is received by several pixels and only one pixel response is extracted. This causes energy loss, which varies as the aliasing effect changes at different micro-lenses the proposed method can reduce overall the energy loss and improve the uniformity as the standard deviation is only about 0.2% of the average value of the gray value. The accuracy is greatly improved compared with the directly extracting method.

		direct method	proposed method
channel 1	ave	97.7260	193.9770
	std	2.0806	0.4262
channel 2	ave	98.3820	192.9595
	std	2.4379	0.3270
channel 3	ave	95.3385	191.7176
	std	1.6018	0.4275



CONCLUSION
We analyze the reasons causing aliasing of the multimode light field image system. Then the data aliasing model is presented along with the reconstruction method. And we prove the effects caused by aliasing and the feasibility of the proposed method through experiment. The results verify the proposed method based on the aliasing model can extract polarization images more accurately, and the brightness variation can be eliminated. As a result, the proposed method is better than the direct method.