29p-PB10-3

Influence on Resolving Power of RMS Aberration of Liquid Crystal Lens

Akita Industrial Technology Center, ○Mao Ye, Bin Wang, Masaru Uchida, Satoshi Yanase, Shingo Takahashi, and Susumu Sato

E-mail: maoye@ait.pref.akita.jp

Introduction Recently, we have reported that the resolving power of an imaging system [1] composed of a camera module and a liquid crystal (LC) lens [2, 3] is close to that of the camera module itself when appropriate voltages are applied. In applications that optical power is required, the LC lens could be driven to output high power at the cost of increasing its optical aberrations. Here, we report the influence of the RMS (root mean square) aberration of the LC lens on the resolving power of the imaging system in which the LC lens acts as a focusing element.

Experimental results The structure of the LC lens is described in Ref. [1]. The lens is driven to work as a positive lens; voltage V_1 is kept constant and voltage V_2 is adjusted to tune the focus. Two driving conditions are tested and the RMS aberrations (Fig. 1) are measured with light wave of 532 nm wavelength. If the lens is driven with frequency f of V_1 and V_2 being 6 kHz and V_1 being 4 V, The aberration is at a low level around 0.05 wave at low optical power P, but rises sharply as P becomes higher than approximately 5 m^{-1}. If the lens is driven with f and V_1 being 8 kHz and 6 V, respectively, RMS aberration turns out to be at a higher level, but it only grows gradually even when P comes to be much higher than 5 m^{-1}.

An ISO 12233 chart is used to measure the MTF (modulation transfer function) of the system [1]. V_2 is adjusted so to obtain the maximum MTF that is considered as the MTF of the system. MTF50 of the system at different distance d of the chart from the system is shown in Fig. 2. Different resolving powers of the system can be seen.

Conclusion The LC lens with lower aberration (f = 6 kHz and V_1 = 4 V) leads to a higher resolving power. With higher aberration (f = 8 kHz and V_1 = 6 V) it outputs higher P making the system be able to focus to nearer objects.

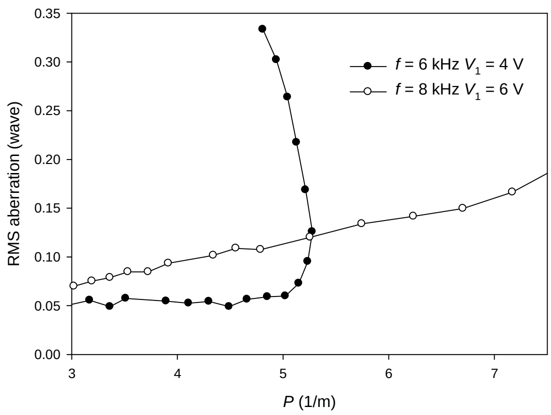

Fig. 1 RMS aberration changing with optical power

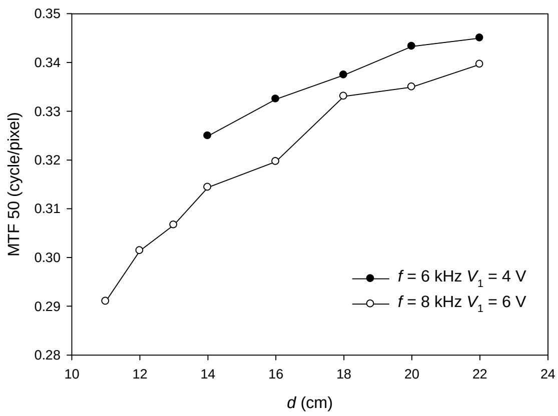

Fig. 2 MTF50 with different driving conditions

References

[1] M. Ye, *et al*., *Appl. Opt.* **51** (2012) 7630.
[2] M. Ye, *et al*., *Appl. Opt.* **43** (2004) 6407.
[3] M. Ye, *et al*., *Jpn. J. Appl. Phys.* **49** (2010) 100204-1.