焦点可変範囲を拡大する液晶レンズ駆動方法

Driving Liquid Crystal Lens to Widen Focus Range

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The liquid crystal (LC) lens [1] with a highly resistive film between the patterned electrode and the LC layer has driving voltages of ~ 3 V_{rms}. Its optical properties are determined by three parameters, that is, the amplitudes and the frequency of the two voltages V_1 and V_2. To drive the LC lens an appropriate frequency is first determined and the amplitude of one of the two voltages remains unchanged while that of the other one tunes the focus. Recently [2], we have proposed an improved driving method. For an LC lens with an aperture of D = 2.0 mm and an LC film (Δn = 0.2) thickness of d = 15 μm, the focus range increases from 3.4 to 5.7 (1/m).

The optical path difference of the ordinary and the extraordinary waves is $d\Delta n$ = 3 μm, and 6 (1/m) positive lens power and -6 (1/m) negative lens power, that is, focus range of 12 (1/m), should be obtained if the path difference is totally made use of. In this work, we propose a new driving method using different frequency for positive and negative lens states. The focus range is extended from 5.3 (1/m) [2] to 6.3 (1/m), and an increase of the utilization of the path difference from 44% to 52% is realized.

The LC lens is driven with frequency of 6.5 and 2.5 kHz, respectively, in positive and negative lens states. The results of rms aberration vs power for the three driving methods are shown in Fig. 1. The increase in the focus range with the new method can be seen.

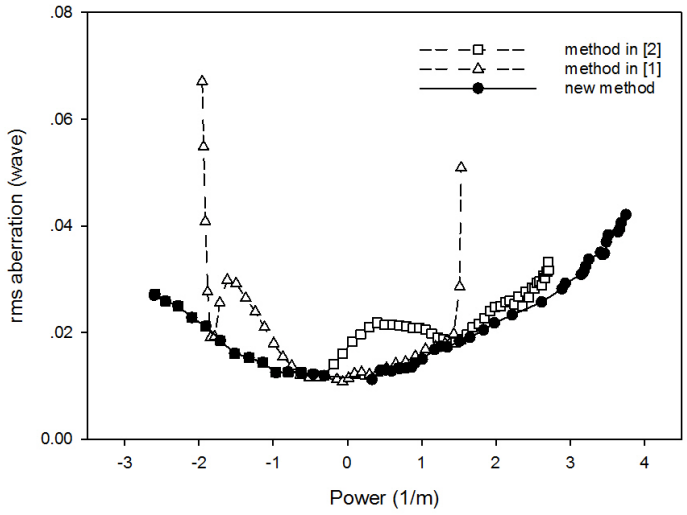

Fig. 1 Comparison of results of rms aberration vs power with the three methods.

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[1] M. Ye, et al., *Jpn. J. Appl. Phys.* **49** (2010) 100204.

[2] X. Chen, et al., *Jpn. J. Appl. Phys.* **57** (2018) 072601.