# Force-induced tunable Lens for Dark-zone Compensation in Stretchable Display

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With the rapid development of Internet of Things (IoT) technology and information technology, display devices play a role conveying information for human-machine interacting, Starting from flat-panel, display is developing more flexible. As foldable and bendable displays have been commercialized, fully stretchable displays able to attach to arbitrary surface adapting to diversity scenarios are attractive.

To construct a stretchable display, the conventional method is to utilize the island-bridge structure with the interconnection set to be serpentine shape to release the stress on the rigid part.[1] However, the clearance between the pixels (i.e. dark zone) induce a sharp decline of the resolution and the active coverage under the tensile process. This severely limit the practical application of stretchable display.[2][3]

Dark zone can be compensated with two methods: sub-pixel compensation method and optical structure compensation method.[3][4] But these methods focus on implanting rigid components into the soft matrix, which is easy to cause interface separation and result in low yield.

In this work, a novel method for dark-zone compensation was proposed based on the force-induced tunable lens. A modulus controllable material (photo patterned PDMS) can be triggered by UV dose with modulus ranged from 1.8MPa to 4MPa. Based on the photomask generated by halftone, the model of the tunable lens was designed, and the biaxial tensile mechanic's simulation was performed on COMSOL Multiphysics to verify its feasibility in the fabrication of concave lenses. The models with different stretch rates of 0%-40% were simulated by Lighttools, and they all showed excellent zoom performance. The full width at half maximum of the focused beam is only 11mm when the meniscus lens is 370mm in diameter. Finally, a stretchable display optical compensation structure based on a flexible tunable lens was proposed, and its compensation effect for the dark zone was verified by optical simulation.

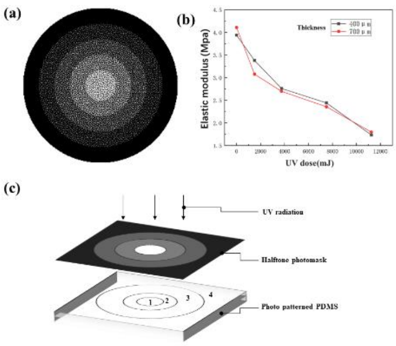


**Fig. 1.** The scheme of the force-tunable lens.

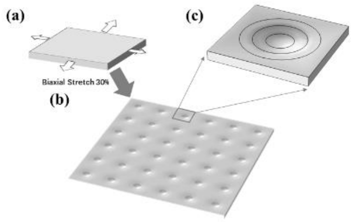


**Fig. 2.** The proposed convex lens formed by biaxial stretch(30%).

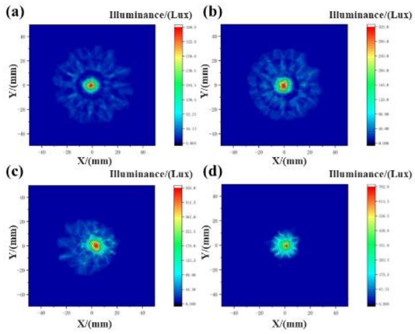


**Fig. 3.** The zoom performance of the force-tunable lens under different stretch ratio(10%-40%).

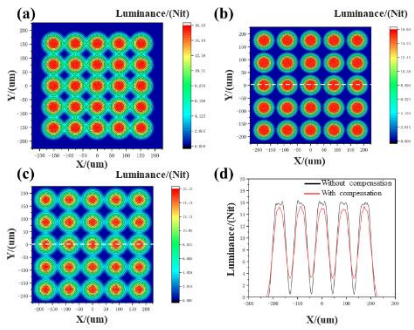


**Fig. 4.** The performance of a stretchable display under different situation. (a) original state. (b)30% biaxial stretch. (c) 30% biaxial stretch with compensation.

## References

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