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Ultrasonic Liquid Crystal Lens which can ChangePosition of Optical Axis and Focal Length without Any Mechanical Part

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KEY WORDS:

In recent years, camera modules have been playing an active role in a variety of situations and are used in various fields such as smartphones, cellular phones, medical devices, and security cameras. Especially in the automotive field, they are widely used as one of the core sensors necessary to recognize the distance to signs, road surfaces, and obstacles. However, in general camera modules, when moving each lens in the unit to the appropriate position, the lens must be continuously moved in the high-axis direction through a mechanical mechanism using piezoelectric elements, stepping motors, etc. In addition, the combination of lenses in the unit is complicated. Furthermore, the more complex the combination of lenses in a unit, the more lenses are required, which inevitably increases the number of mechanical mechanical parts. For this reason, many technologies have been developed to reduce the size and weight of optical systems, as well as the cost of materials and assembly.

In this paper, we have adopted a technology that creates a lens effect with ultrasonic waves instead of the electrode system used in conventional liquid crystal lenses, with the aim of developing a liquid crystal lens that can realize variable optical axis position and magnification. Furthermore, experiments using simulations are conducted to demonstrate the optimum placement of the transducers and the possibility of variable optical axis position, and the results are discussed.

The simulation results are shown in Figure 1. It was confirmed that the closer the array shape is to a circle, the closer the sound pressure distribution becomes to a regular circle. The figure also shows that moving the focal point does not have a lensing effect because the sound pressure distribution is disturbed when the focal point is not circular. Based on the above results, the method of arranging the transducers in a circle was adopted.

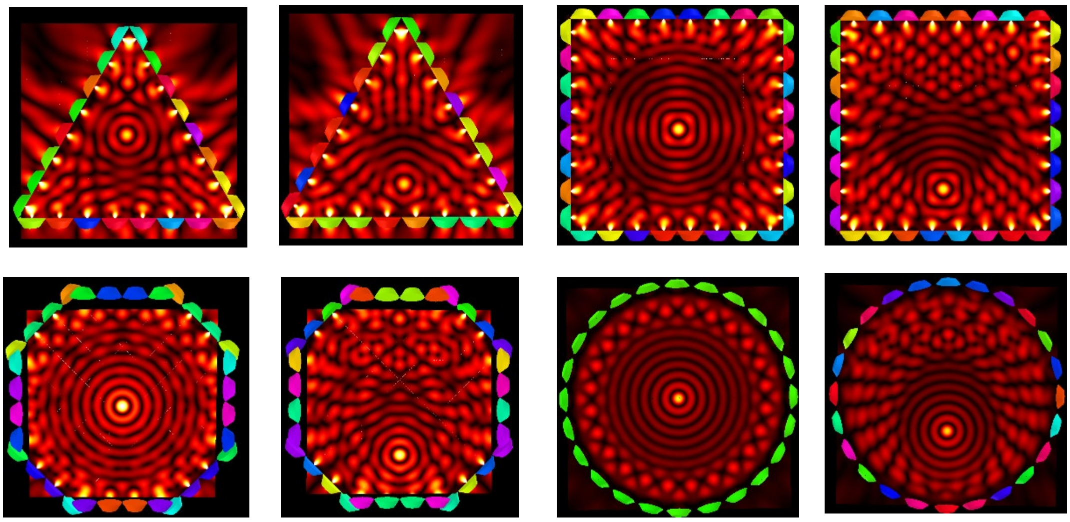

Fig.1 Simulation results for triangular, square, octagonal, and circular transducers (left: sound pressure distribution when the focus is specified at the center, right: sound pressure distribution when the focus position is shifted downward)