Metasurface In-coupler Design for Single RGB Waveguide with Wire Grid Polarizer

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Recent research in augmented reality is actively ongoing worldwide, and there is fierce competition in developing ideal AR devices. The goal of an ideal AR device is to present small form factor and to see high resolution images directly to the eyes [1]. Conventional AR devices using waveguide are designed with 3 layered waveguides to achieve RGB system. However, this approach has the disadvantage of a large form factor due to the 3-layer structure. In addition, traditional AR combiners have a flat design, which makes them less visually appealing than standard glasses. This is a significant drawback for consumers. Therefore, this research introduces a design approach for a curved single RGB waveguide to overcome the limitations of conventional AR glasses, specifically their large form factor and flat surfaces. The research also presents a method for designing a high-efficiency Metasurface using adjoint-based topology optimization [2] to implement the curved waveguide.

In general, spatial light modulators (SLMs) have a rectangular shape, and to ensure uniformity in the output regions of duplicated SLMs, the optical path length needs to be extended in the longer sections. Therefore, a new waveguide with shoe structure is developed to make a uniform output region without sim area.

The RGB in-coupler based on Metasurface is calculated by adjoint inverse design, and the optimization process was carried out using a simulation tool developed on the Fourier Modal Method (FMM) basis [3]. The Metasurface is assumed to consist op pixels with relative permittivity of dielectric materials, and the distribution of permittivity in the meta-lattice region was set as the design variable for optimization. As iterations progress, the permittivity of the layers is modified.

This paper presents a method to implement a single RGB waveguide using the Metasurface designed through inverse design and a wire grid polarizer (WGP) waveguide. The AR glasses realized through this method will be also introduced.

References

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