Near-Eye Displays Using Chiral Liquid Crystal Gratings for Metaverse

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We present a near-eye display (NED) featuring a triple-channel waveguide for metaverse [1]. Fig. 1 shows a cross-section of our triple-channel waveguide, with its top, middle and bottom layers being referred to as channel 1, channel 2 and channel 3, respectively. The input field of view (FOV) is divided equally into left (FOV_1), center (FOV_2) and right (FOV_3) sub-FOVs, which in turn carry the left-handed (L), right-handed (R) and left-handed circular polarizations. Accordingly, gratings—including the in-coupling and out-coupling—of channel 1/2/3 are responsive merely to $FOV_{1/2/3}$. This can be fulfilled by adjusting both the polarization selectivity and tilt angles $\theta_{1/2/3}$ of gratings. As a viable option, we opt for chiral liquid crystals [2] as both in-coupling and out-coupling gratings. The greatest benefit of triple-channel waveguide is that, FOV wise, it beats out both the single-channel [3] and dual-channel waveguides [4]. Say the refractive index of waveguide equals 1.8, the upper limit of FOV is 60°/88°/121° for the single/dual/triple-channel waveguide, respectively. Another benefit is that the out-coupling regions of different channels could be overlapped. Our results demonstrate that its diagonal FOV reaches 90°, eye relief is 10 mm, exit pupil is 4.9 × 4.9 mm^2, transmittance is 4.9%, and uniformity is 89%.

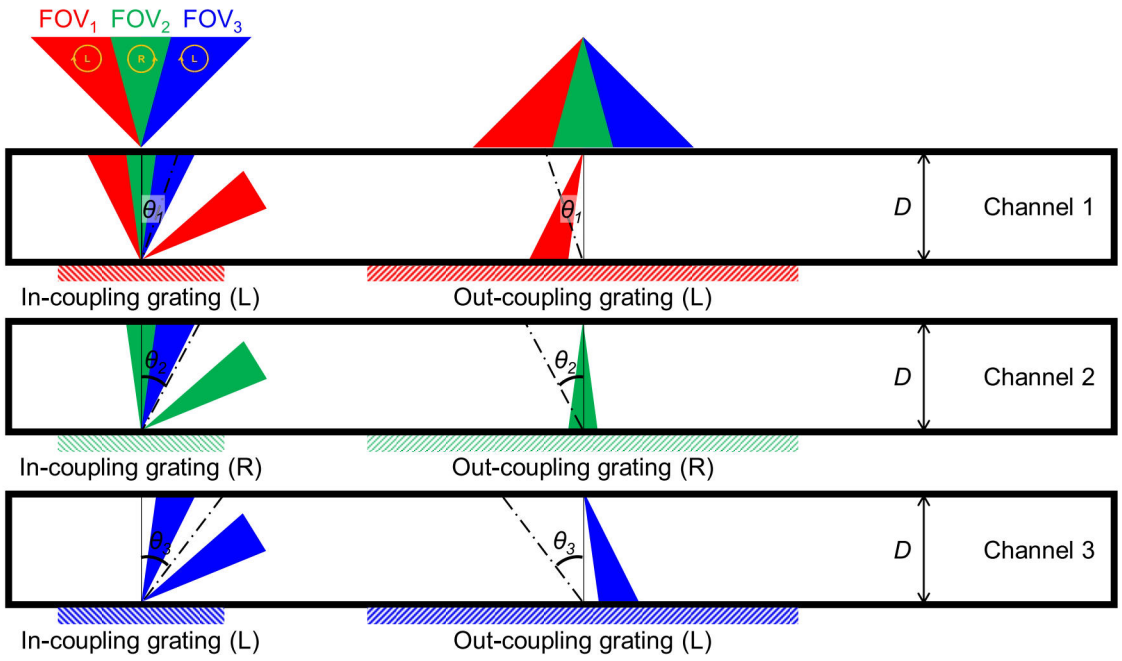

Fig. 1. Schematic drawing of the proposed triple-channel waveguide.

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