超高计算&显示帧率的超表面动态全息显示

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当前，大多数超表面动态全息显示方案难以实现高显示帧率，这限制了其在提供流畅视觉体验方面的能力。

华中科技大学武汉光电国家研究中心的熊伟教授和高辉副教授的团队提出了一种具有高计算帧率和显示帧率的动态交互位超表面全息术 (Bit-MH) 技术，并搭建了全球首台实用化的可交互式超表面全息显示系统。研究团队将超表面的显示功能划分为不同的空间区域 (即空间信道)，每个信道可以投影一个重建的子全息图案。通过光寻址空间通道复用技术，将所有信道的开关状态映射到一组比特值，进而将动态全息的更新过程映射为了操纵这组比特值来控制对应的信道的开启或关闭状态。相比于传统的动态全息的更新过程中需要频繁的利用 FFT 来计算全息图的复杂运算过程，该研究方案利用映射的按位运算极大地提升了计算效率，实现了高效的动态刷新。

研究人员在低功耗的树莓派计算平台对按位动态全息的核心算法执行了基准测试，结果表明，按位动态全息方案的最大计算帧率可达 800 kHz，同时利用高速的 DMD 设备光寻址设备，可以实现的最大显示帧率达到 23 kHz。

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Dynamic interactive bitwise meta-holography with ultra-high computational and display frame rates

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At present, most dynamic holographic display strategies based on metasurfaces struggle to achieve high display frame rates, which hampers their ability to deliver a fluid visual experience.

Addressing the aforementioned challenges, a team led by Prof. Xiong Wei and Associate Prof. Gao Hui from the Wuhan National Laboratory for Optoelectronics at Huazhong University of Science and Technology has introduced a dynamic interactive bitwise metasurface holography (Bit-MH) technique with high computational and display frame rates. They have constructed the world's first practical interactive metasurface holographic display system. In their study, the team segmented the display functionality of metasurfaces into distinct spatial regions or channels, with each capable of projecting a reconstructed sub-holographic pattern. Utilizing optical addressing for spatial channel multiplexing, they mapped the on/off states of all channels to a set of bit values, thus transforming the dynamic updating process of holography into the manipulation of these bit values to control the corresponding channels.

The researchers performed benchmark tests of the core algorithm for bitwise dynamic holography on a low-power Raspberry Pi computing platform, revealing that the maximum computational frame rate of the bitwise dynamic holography approach can reach up to 800 kHz.

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