基于级联液晶全息图的多维复用光学秘密共享

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近年来涌现的超表面全息复用技术，满足了光学系统小型化、集成化的迫切需求，但受限于精密的加工要求和材料固有物理属性，在构建具有动态可调性以及高衍射效率的级联光学秘密共享平台方面仍面临巨大挑战。

上海理工大学光子芯片研究院的顾敏院士团队与南京大学陆延青教授团队通力合作，联合提出了一种基于级联液晶全息图的多维复用光学秘密共享方案，其中入射光的偏振态和液晶全息片之间的距离作为密钥用于实现信息加密。他们在设计过程中使用角谱衍射理论，创建了一个误差反向传播神经网络，完成了复杂的多约束和级联多层问题的逆向设计。网络在加密过程中的多维输入，如入射光的偏振态、级联液晶分享份所施加的外部电压及其之间的距离，显著增强了秘密信息的安全性，且允许同时进行多条信息的超高安全传输，克服了传统全息加密方法的不足，具有许多优势。

液晶元件的成熟制造技术使该方案更加实用和多功能，凭借便捷的设计、低成本的制造和超高的安全性，该多维多路复用光学秘密共享方案在超高容量信息存储、动态全息显示和多功能光学信息处理等方面具有巨大应用潜力。

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Multi-dimensional multiplexing optical secret sharing framework with cascaded liquid crystal holograms

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For the realization of low-cost, convenient, high-efficiency, and high-capacity cascaded optical secret sharing schemes, anisotropic structured liquid crystal optoelectronic materials with high diffraction efficiency and voltage-tunable switch features provide a novel approach.

Recently, the team of Prof. Min Gu from the Institute of Photonics Chips at the University of Shanghai for Science and Technology, in collaboration with Prof. Yanying Lu's team from Nanjing University, proposed a multi-dimensional multiplexing optical secret sharing framework with cascaded liquid crystal holograms. In this framework, the polarization state of the incident light and the distance between the liquid crystal holograms are used as the decryption keys of encrypted information. They created an error back-propagation neural network with angular spectrum diffraction theory, accomplishing the inverse design of complex multi-constraint and multi-layer cascading problems. The multi-dimensional inputs in the encryption process of the network, such as the polarization state of the incident light, the external voltage applied to the cascaded liquid crystal shares and their distances, significantly enhance the security of the secret information.

The mature manufacturing technology of liquid crystal components makes this framework more practical and multifunctional. This multi-dimensional multiplexing optical secret sharing scheme has great potential in applications of ultra-high capacity information storage, dynamic holographic display, and multifunctional optical information processing.

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