复杂环境下部分相干涡旋光场轨道角动量鲁棒检测技术

DOI: 10.12086/oee.2025.251003.h03

如何准确检测部分相干涡旋光束的轨道角动量信息在众多应用领域 (如 OAM 复用光通信等) 中是关键的一步。如何在复杂传输环境中准确地测量部分相干涡旋光束所携带的轨道角动量信息是一个关键的科学问题，具有重要的应用价值。

山东师范大学光场调控及应用中心蔡阳健教授团队提出了一种基于交叉相位调控检测方案，实现了在复杂环境中对部分相干涡旋光束轨道角动量信息的准确测量。在该项工作中，研究团队仅借助交叉相位对空间相干结构的各向异性调控，实现了拓扑荷/轨道角动量信息的鲁棒传输与远场检测。交叉相位产生的模式转换特性，可使隐藏在相干结构中的轨道角动量/拓扑荷信息以分离的环形暗环相干奇点结构显现出来。该方法不仅适用于自由空间传输环境下的检测，同样适用于有障碍物遮挡和大气湍流扰动的传输环境下的检测。

实验结果表明，通过调控交叉相位，部分相干拉盖尔高斯光束的相干结构在大气湍流与障碍物遮挡作用下依然可以保持稳定的空间结构分布。该研究方法和结果在基于复杂环境中的光信息加密、自由空间光通信等方向具有潜在的应用价值。

Opto-Electronic Science, 2024, **3**(1): 240001.
https://www.oejournal.org/article/doi/10.29026/oes.2024.240001.

Robust detection technology of orbital angular momentum of partially coherent vortex light fields in complex environment

DOI: 10.12086/oee.2025.251003.h03

How to accurately detect the OAM information of partially coherent vortex beams is a key step in many application fields, such as OAM multiplexing optical communications. How to accurately measure the orbital angular momentum information carried by partially coherent vortex beams in complex transmission environments has become a key scientific issue and has important application value.

The group of Prof. Cai Yangjian from the Center for Light Field Regulation and Application of Shandong Normal University propose a detection scheme based on cross-phase control, achieving accurate measurement of the OAM information of partially coherent vortex beams in complex environments. Robust transmission and far-field detection of topological charge/OAM information was achieved by only relying on the anisotropic control of the spatial coherent structure by cross-phase. The mode conversion property induced by the cross-phase can make the OAM/topological charge information hidden in the coherent structure emerge as a distribution with multiple isolated dark rings.

The results show that by modulating the cross-phase, the coherent structure of a partially coherent Laguerre Gaussian beam can still maintain a stable spatial distribution under the effects of atmospheric turbulence and obstacles.

Opto-Electronic Science, 2024, **3**(1): 240001.
https://www.oejournal.org/article/doi/10.29026/oes.2024.240001.