结构光开始变得丰富多彩

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光就像布料一样，可以量身定制，能够将图案编织和缝合到光的本体之中。这种所谓的结构光使我们可以访问、控制和探索所有光的自由度，以便在成像中看到更小的图像，在显微镜中更紧密地聚焦，并将更多信息加载到光中，用于经典光通信和量子通信。

南非威特沃特斯兰德大学的 Andrew Forbes 教授研究小组回顾了利用非线性光学作为结构光产生、控制和探测新工具的研究进展，为这一新兴课题的发展提供了新的见解和视角。在这项工作中，研究小组展示了用非线性控制取代传统线性光学调控工具的最新研究进展。从历史上看，非线性光学与波长控制有关；但 Forbes 教授指出，景物远比结构光呈现的颜色更加丰富多彩，有时会以反直观的方式影响所有自由度。这项工作中的非线性光学控制高级工具包保证了从经典到量子光通信的新型应用，开创了结构光的新篇章。

结构光寻求利用光的多自由度影响光的“结构”。研究人员展示了具有非线性光学特性的结构光如何超越线性光学调控工具，以非同寻常的方式调控自由度，改变选择规则，有时可以产生反直观的结果。

研究人员利用非线性光学原理研究结构光，并针对该主题从基础理论到应用技术进行了整体介绍。

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Structured light just got colourful

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Light can be tailored, much like cloth, weaving and stitching a pattern into the very fabric of light itself. This so-called structured light allows us to access, harness and exploit all light’s degrees of freedom, for seeing smaller in imaging, focusing tighter in microscopy and packing more information into light for classical and quantum communications.

The research group of prof. Andrew Forbes from the University of the Witwatersrand showcase the recent advances in replacing the traditional linear optical toolkit with nonlinear control. They review the recent progress in using nonlinear optics as a new tool for the creation, control and detection of structured light, offering new insights and perspectives on this nascent topic. Structured light seeks to harness light’s many degrees of freedom, to impact “structure” to the light. This could be in amplitude, phase, polarisation or even more exotic degrees of freedom such as path, orbital angular momentum and even spatiotemporal control. To date, this has mostly been achieved with a linear optical toolkit, with nonlinear optics used to change the colour of the light (its wavelength and frequency).

They show how structured light with nonlinear optics can surpass the linear toolkit, mixing degrees of freedom in unusual ways, altering selection rules and producing sometimes counter-intuitive results. They unpack the physics of nonlinear optics in the context of structured light, the first report to do so, and offer a holistic introduction to the topic from fundamentals to applications.

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