Nonorthogonal multiplexing in multimode fiber empowered by deep learning

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Multidimensional optical information multiplexing is a key feature of high-capacity optical fiber communication systems. The physical orthogonality among multiplexed channels significantly reduces the complexity of digital signal processing. However, the orthogonality nature inevitably imposes an upper limit on the capacity of transmission systems. If the constraints of multiplexing orthogonality can be eliminated, the freedom and capacity of optical transmission systems will be dramatically improved. Compared to single-mode optical fibers, multimode optical fibers, which support the transmission of multiple modes in parallel, are a potential transmission medium for short-distance, high-capacity optical communications. In this talk, we will introduce the concept of non-orthogonal optical multiplexing in a multimode fiber leveraged by the deep learning approach. Spatial overlapping non-orthogonal multiplexing input channels with the same polarization and wavelength can be explicitly demultiplexed when the signal propagates through the multimode fiber. We will discuss the advantages and limitations for this data-driven non-orthogonal multiplexing method. Our results resemble an important step for harnessing non-orthogonal channels for high-capacity optical multiplexing, which can be generalized to other wave physical systems.

Short Bio:

Yuwen Qin received the Ph.D. degree from Tianjin Universityin 1996. He is currently a Professor with Institute of Advanced Photonics Technology, and Key Laboratory of Photonic Technology for Integrated Sensing and Communication, Ministry of Education of China, Guangdong University of Technology. He take his postdoctoral work position in Beijing Jiaotong University and Virginia Tech in 1996 and 2000,

respectively. He was Executive Director of the Department of Information Sciences of National Natural Science Foundation of China and Deputy Editor of SCIENCE CHINA Information Sciences, and is now with Editorial board of Light：Science & Applications. Currently, he is managing director of Chinese Society for Optical Engineering (CSOE), and Deputy Director of fiber optics and integrated optics committee of the Chinese Optical Society (COS). He is a Principal Investigator of National Key Research and Development Program of China, Joint Key Program Funds of the National Natural Science Foundation of China, and Research and Development Plan in Key Areas of Guangdong Province. His current research interests mainly include spatial division multiplexing transmission, distributed fiber sensing, and integration of fiber optical communication and sensing.

中文题目：深度学习赋能多模光纤的非正交复用

中文摘要：光信息多维复用是大容量光纤通信系统的重要特征，复用信道间传输信息的物理正交性大幅度降低了解复用系统的复杂性。然而对正交性的依赖必然导致传输系统的容量存在上限，如果可以摆脱复用正交性的掣肘，实现光信息非正交复用，能够进一步提升光纤通信系统的复用自由度和传输容量。相较于单模光纤，支持大量模式并行传输的多模光纤是实现短距大容量光纤通信的潜在传输介质。本报告将介绍基于深度学习的多模光纤非正交复用原理，具有相同偏振和波长的空间重叠非正交输入光信号，通过多模光纤传输后，通过深度神经网络可以实现解复用。我们将讨论这种数据驱动非正交复用的实施方案和性能评估，为利用非正交复用实现大容量光传输提供新思路。

中文简历：秦玉文，教授、广东工业大学先进光子技术研究院院长，通感融合光子技术教育部重点实验室主任。博士毕业于天津大学，先后在北京交通大学和弗吉尼亚理工学院和州立大学从事博士后研究。曾任国家自然科学基金委信息科学部常务副主任、《中国科学：信息科学》副主编等职务，目前兼任中国光学工程学会常务理事、中国光学学会纤维光学与集成光学专委会副主任、《Light:

Science &Applications》等学术期刊编委。主要从事光纤通信和光纤传感领域的研究工作。先后主持国家重点研发计划项目、区域联合基金重点项目、广东省重大研究专项等多项项目。