

## Optical multiplexing techniques and their marriage for on-chip and optical fiber communication: a review

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Optical multiplexing is an imperative topic and intense research is carried out throughout the world. Different multiplexing techniques, for example, wavelength division multiplexing (WDM), mode division multiplexing (MDM), space division multiplexing (SDM), polarization division multiplexing (PDM) and orbital angular momentum multiplexing (OAMM) have been proposed over the years.

The research group of Prof. Khonina from Image Processing Systems Institute of the Russian Academy of Sci-

ence have fabricated several diffractive optical elements for the realization of MDM in free-space and fiber optics. Based on their experience in this vast field, they have tried their best to review recent advancements in the world of multiplexing. The topics covered in this review are WDM, PDM, SDM, MDM, OAMM and three hybrid techniques such as WDM-PDM, WDM-MDM and PDM-MDM. It is probable to accomplish  $N \times M$  channels by utilizing  $N$  wavelengths and  $M$  guided-modes by simply utilizing hybrid WDM-MDM (de)multiplexers. To the best of the authors' knowledge, this review paper is one of its kind which has highlighted the most prominent and recent signs of progress in multiplexing techniques in one place.

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## 光复用及其混合技术在片上系统和光纤通信中的应用

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光复用技术是一项迫切的研究课题, 全世界范围内的学者都在对这一领域进行着深入的研究。多年来, 人们提出了波分复用 (WDM)、模分复用 (MDM)、空分复用 (SDM)、偏振复用 (PDM) 和轨道角动量复用 (OAMM) 等多种复用技术。

俄罗斯科学院图像处理系统研究所的 Khonina 教授研究团队近期发表了相关综述文章。他们研发了几种衍射光学元件, 用于在自由空间和光纤中实现 MDM。但网络带宽就像“自家的衣柜”一样, 永远不嫌太大, 永远不够用。数据流使得对通信量的需求呈

爆炸性增长。简短的电子邮件消息正在占用带宽的动画图像所代替。对于几年前还拥有足够带宽的数据、视频和语音信号广播网络, 现在各国电信部门却希望能采用一种打破常规的方法来满足对带宽的无休止的需求。基于在这一研究领域的大量经验, Khonina 教授尽可能地总结了多路复用领域的最新且最重要的进展。综述涵盖的主题包括 WDM、PDM、SDM、MDM、OAMM, 以及 WDM-PDM、WDM-MDM 和 PDM-MDM 三种混合技术。其中, 仅靠利用混合 WDM-MDM 多路调制 (分配) 器,  $N \times M$  个信道就能通过  $N$  个波长和  $M$  个导模实现。

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