Nonlinearity-Tolerant Fiber for Greater Transmission Capacity in Optical Communications

A new alternative that combines the benefits of single-mode and multi-mode fibers, few-mode fiber can avoid problems associated with nonlinearity and with mode coupling.

Though single-mode fiber offers advantages over multi-mode fiber in long distance optical communications, its performance is compromised by nonlinearity problems including self-phase modulation (SPM), cross-phase modulation (XPM), and four-wave mixing (FWM). Nonlinearity problems reduce transmission capacity, and existing methods of compensating for this are only partially effective. Multi-mode fiber was considered in the past for long distance optical communications because it solves the nonlinearity problems associated with single-mode fibers, but was eventually abandoned due to the problem of mode coupling. Mode coupling can be reduced when the propagation properties, especially propagation constants, of supported modes are as different as possible. This difference between modes is increased by reducing the number of modes supported by the fiber.

Technical Details
Single-mode fiber has been the choice in long-haul fiber transmission for its dispersion control. UCF researchers now propose using multi-mode fibers to increase nonlinearity tolerance, and with it, a new approach to combating fiber transmission impairments including dispersion and nonlinearity. Multi-mode fibers reduce nonlinearity compared to single-mode fibers by increasing the mode field diameters of all modes involved. This shifts the burden from compensating for nonlinearity to the more solvable problem of managing dispersion, which can be compensated optically and electronically.

UCF Inventors
Guifang Li, Ph.D.; Neng Bai, Ph.D.; Cen Xia; Xiaobo Xie, Ph.D.; Fatih Yaman; Likai Zhu, Ph.D.

Benefits
- Higher transmission capacity
- Nonlinearity-tolerant
- Shifts burden of compensation to linear issues that are more easily solved

Applications
- Long-haul optical communications

Tech Field
Optics & Lasers

Keywords
long-haul optical communication, transmission capacity, nonlinearity, dispersion control

US 2013/0064554 A1
WO 2011/094400 A2