光纤传感和光通信

多模光纤模式场群速与相速的关系

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摘要：

为了从理论上统一射线光学和导波光学关于多模光纤中各模式场传播过程中时延的论述，试从介质波导理论出发，根据模式的特征根U随光纤归一化频率R的变化关系，在弱波导近似下导出了描述模式场相速Vp与群速Vg关系的重要结果：$Vp*Vg=(c/n1)2$。根据这一结果可以得出结论：对于低阶模式，由于相速Vp慢，所以群速快；高阶模式其相速Vp快，所以群速慢。对于给定的光纤，利用射线光学和波导光学进行了带宽估计，2种理论计算结果的一致性，印证了上述关系的正确性。

关键词：　多模光纤模式场　模式特征方程　波导理论　相速与群速

Relationship between group velocity and phase velocity of the mode-field on multi-mode fiber

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Abstract:

To clarify the discussion on ray optics and wave optics on the delay of mode field propagation process in the multimode fiber theoretically, the relationship between phase velocity Vp and group velocity Vg is derived, $Vp*Vg=(c/n1)2$, according to the relationship between the mode characteristic roots U and the optic fiber normalized frequency R, as well as the weak waveguide approximation theory. Based on the results, it is concluded that phase velocity is slow and group velocity is fast at low-order mode, phase velocity is fast and group velocity is slow at high speed mode. Ray optics and wave optics are used for bandwidth estimation to a given optical fiber, and the consistency of the results of two theoretical calculations confirms the correctness of these relations.

Keywords: multi-mode fiber mode field   mode eigen-equation   waveguide theory   phase velocity and group velocity

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