Simulation for multimode fiber towaveguide interconnection based on Near-field and far-field pattern

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Abstract: For optical interconnection in the short distance information transmission systems, a loss test of the fiber-waveguide connector is performed to guarantee that the loss budget satisfies the requirement before the implementation. We propose a simulation model that can be adapted to practical application. The model is using measured data of near and far field patterns, and the interconnection loss is becoming predictable.

1. Introduction

Multimode fiber (MMF), especially graded-index multimode fiber (GI-MMF), has received widespread attention in the field of short-distance optical communication as one of the promising applications, with its characteristics of light in weight, free from electromagnetic interference, and higher bandwidth. For an optical transmission system to operate effectively, the loss of the fiber link must meet the loss budget. It is important to predict losses through simulation to reduce cost and time before integrating fiber into actual systems. Therefore, a practical simulation method needs to be established to accurately estimate the MMF connection loss. A calculation model of connection loss applicable to SI-MMFs and GI-MMFs has been demonstrated successfully [1]. In practical applications, we will encounter the case where the multimode fiber is connected to the optical waveguide, and the rectangular optical waveguide is especially used in this study. Different end face shapes may limit and affect applicability. Our purpose is to use the measured data of near field pattern (NFP) and far field pattern (FFP), and use NFP and FFP as the light source to simulate and finally get the connection loss.

2. Method

The simulation is based on the optical design software, OpticStudio. Using the nonsequential component editor to operate geometric optics, and calculate the connection loss by numerical analysis. Figure 1 shows the geometric model of the proposed simulation. In this case, the graded index fiber has a core diameter of 50μm, and has 1.482 refractive index; the rectangular waveguide has an end face size of 50μm×50μm, and has 1.54 and 1.51 refractive index of core and cladding respectively; the wavelength is set to be 850nm.

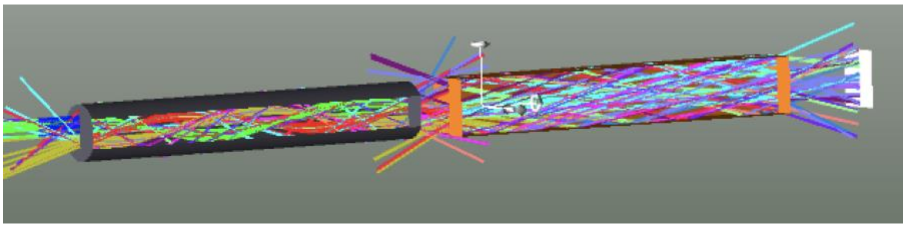

Fig.1 Schematic diagram of the light tracing for optical fiber and optical waveguide

Unlike geometric modeling mentioned above, only the situation between the two end faces needs to be considered so it is necessary to use the measured data of NFP and FFP as the plane light source to analyze the light intensity distribution and the spatial position changes of two end faces, such as distance and axial misalignment. In addition, the occur of Fresnel reflections needs to be considered into account in the total loss.

3. Conclusion

A simple simulation model of interconnection for multimode fiber and rectangular has been actualized. By measuring NFP and FFP and applying them to the simulation, the connection loss due to spatial variation between the fiber and the rectangular waveguide can be analyzed, calculated, and predicted. We will simulate more models for different types of waveguides, such as graded index types or step-graded index composite types, in the future.

References

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