frontiers | Frontiers in Physics

ORIGINAL RESEARCH
published: 25 May 2022
doi: 10.3389/fphy.2022.927907

Calculation of the Coupling Coefficient in Step-Index Multimode Polymer Optical Fibers Based on the Far-Field Measurements

Svetislav Savović[1,2], *Alexandar Djordjevich*[3], *Branko Drljača*[4], *Ana Simović*[2] *and Rui Min*[1]*

[1]Center for Cognition and Neuroergonomics, State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Zhuhai, China, [2]Faculty of Science, University of Kragujevac, Kragujevac, Serbia, [3]Department of Mechanical Engineering, City University of Hong Kong, Kowloon, China, [4]Faculty of Sciences, University of Priština in Kosovska Mitrovica, Kosovska Mitrovica, Serbia

Using the power flow equation (PFE), this article investigates mode coupling in step-index (SI) multimode (MM) polymer optical fiber (POF). This equation's coupling coefficient was initially fine-tuned so that it could appropriately reconstruct previously recorded far-field (FF) power distributions. The equilibrium mode distribution (EMD) and steady-state distribution (SSD) in the SI MM POF were found to be obtained at lengths L_c = 15 m and z_s = 41 m, respectively. These lengths are substantially shorter than their glass optical fiber counterparts. Such characterization of the investigated POF can be used in its employment as a part of the communication or sensory system. Namely, the POF's bandwidth is inverse linear function of fiber length (z^{-1}) below the coupling length L_c. However, it has a $z^{-1/2}$ dependence beyond this equilibrium length. Thus, the shorter the coupling length L_c, the sooner transition to the regime of slower bandwidth decrease occurs. It is also important to be able to determine a modal distribution at a certain length of the POF employed as a part of optical fiber sensory system.

Keywords: polymer optical fiber, modal distribution, coupling length, bandwidth, distance dependence, sensory system

OPEN ACCESS

Edited by:
Sushank Chaudhary, Quanzhou Institute of Equipment Manufacturing (CAS), China

Reviewed by:
Lei Liu, Harbin Engineering University, China
Yuyang Peng, Macau University of Science and Technology, Macao SAR, China

***Correspondence:**
Rui Min
ruimin@bnu.edu.cn

Specialty section:
This article was submitted to Optics and Photonics, a section of the journal Frontiers in Physics

Received: *25 April 2022*
Accepted: *09 May 2022*
Published: *25 May 2022*

Citation:
Savović S, Djordjevich A, Drljača B, Simović A and Min R (2022) Calculation of the Coupling Coefficient in Step-Index Multimode Polymer Optical Fibers Based on the Far-Field Measurements. Front. Phys. 10:927907. doi: 10.3389/fphy.2022.927907