High precision Cross-correlated imaging in Few-mode fibers

The trend of increasing data traffic in conventional communication systems demands utilizing new methods for data transmission, which in combination with traditional techniques, enable overcoming the predicted capacity limit. Mode division multiplexing (MDM), where higher-order modes (HOMs) in a few-mode fiber (FMF) are used as multiple spatial communication channels, comes in this context as a viable approach to enable the optimization of high-capacity links. From this perspective, it becomes highly necessary to possess a diagnostic tool for the precise modal characterization of FMFs. Among existing approaches for modal content analysis, several methods as S2, C2 in time and frequency domain are available. In this contribution we will present an improved time-domain cross-correlated (C2) imaging technique for the experimental evaluation of modal properties in HOM fibers over a broad range of wavelengths. Our modified setup makes it possible to adjust the time resolution of the system according to the needs of the required fiber measurement. We show that by tuning the spectral shape of the source (SuperK EXTREME filtered by SuperK Select), we enhance the time resolution of the system, which allows us to distinguishing differential time delays between HOMs in the picosecond timescale. Broad wavelength scanning in combination with spectral shaping, allows us to estimate the modal behavior of FMF without prior knowledge of the fiber parameters. We performed our demonstration at wavelengths from 850nm to 1100nm which can be easily extended to other wavelengths of interest just by replacing components with the appropriate coating. The method presented here aims to serve as flexible diagnostic tool that can be implemented in MDM systems for judicious evaluation of modal dispersion in FMFs.

General information

Publication status: Published
Organisations: Department of Photonics Engineering, Fiber Optics, Devices and Non-linear Effects, Centre of Excellence for Silicon Photonics for Optical Communications, NKT Group
Contributors: Muliar, O., Usuga Castaneda, M. A., Kristensen, T., Alkeskjold, T. T., Rottwitt, K., Lægsgaard, J.
Number of pages: 7
Publication date: 2017

Host publication information
Title of host publication: Proceedings of SPIE
Volume: 10130
Publisher: SPIE - International Society for Optical Engineering
Article number: 101300T
ISBN (Print): 9781510607019
Keywords: Mode division multiplexing, Few mode fiber, Cross-correlated imaging, Mode characterization, Higher order mode

Electronic versions:
101300T.pdf
DOIs:
10.1117/12.2250532

Bibliographical note
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Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2017 › Research › peer-review