

Article Overview

Fiber optic communication links achieve high anti-interference performance through advanced signal processing, multipath mitigation, and crosstalk suppression techniques, ensuring reliable high-speed data transmission.

Key Interference Sources

Fiber optic links face several interference challenges:

- o Linear interference from multi-channel transmission and orthogonal frequency division multiplexing (OFDM) systems, which can distort subcarrier signals .
- o Multipath interference (MPI) caused by reflections at fiber connectors, leading to irregular intensity fluctuations in PAM4 or IM/DD systems .
- o Intra-core and inter-core crosstalk in multi-core fibers (MCF), which can degrade signal-to-noise ratio (SNR) and limit transmission performance .
- o Nonlinear effects, primarily the Kerr effect, and amplified spontaneous emission (ASE) noise, which interact with chromatic dispersion and affect high-power or long-distance links .

Anti-Interference Techniques

o Adaptive Signal Processing

- o Time-varying multipath fading suppression and adaptive beamforming improve relay protection signal transmission by dynamically adjusting to channel conditions .
- o Two-dimensional joint processing (STAP) and channel balancing enhance processing gain and reduce SNR loss caused by noise quadratic terms .

o Linear Interference Suppression

- o Combining Discrete Fourier Transform (DFT) and Wavelet Transform (WT) allows precise identification and filtering of linear interference signals in multi-channel OFDM systems. The DFT-WT-LAJ algorithm effectively reduces interference amplitude and maintains high SNR .

o Multipath Interference Mitigation

- o Instantaneous Mean Intensity Addressing (IMIA) uses real-time noise extraction tables to suppress MPI in PAM4 IM/DD systems, improving tolerance by 4-6 dB. Integration with noise whitening filters (NWF) and maximum likelihood sequence estimation (MLSE) further enhances performance .

o Crosstalk and Nonlinear Noise Management

- o In multi-core fibers, intra-core nonlinear interference (NLIN) and nonlinear inter-core crosstalk (NICXT) are

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mitigated by optimizing transmitted power and using weakly coupled fiber designs. Analytical models based on coupled mode theory help predict and reduce crosstalk effects .

- o Nonlinear-Fourier-transform (NFT) techniques and digital signal processing (DSP) compensate for Kerr nonlinearity and chromatic dispersion, improving the effective SNR in high-capacity systems .

Performance Metrics

- o Signal-to-Noise Ratio (SNR): A primary measure of anti-interference performance, influenced by crosstalk, multipath reflections, and nonlinearities .

- o Interference-to-Signal Ratio (ISR): Algorithms like DFT-WT-LAJ maintain ISR above 31 dB, ensuring reliable transmission .

- o Forward Error Correction (FEC) Tolerance: MPI mitigation schemes improve FEC performance, allowing higher data rates with reduced error probability .

Conclusion

The anti-interference performance of fiber optic communication links is enhanced through a combination of adaptive beamforming, linear and nonlinear interference suppression, multipath mitigation, and crosstalk management. These techniques collectively improve SNR, reduce error rates, and enable high-speed, long-distance, and multi-channel optical communication systems to operate reliably under challenging conditions .

Free-space optical (FSO) communication has emerged as a transformative technology with immense potential for

Under link budget design, the received optical power can be easily estimated in a fiber optic communication, whereas, it

Fiber optics: an antidote to electromagnetic interference (EMI) Abstract: Summary form only given, as follows. As

This article discusses the common issues experienced in fiber optic performance. Common

We propose a design approach for a fiber-optic relaying considering the performance of the optical link and

An important technique for preserving remote access to broadband wireless communication is radio over fiber (ROF).

Anti-interference performance of fiber optic communication links

Fiber optic cables are essential components in modern data transmission infrastructure. They support high-speed, interference

NOVALYNX provides interference-free fiber optic reel kits for UAVs, FPV drones, and defense systems. Secure, plug-and-play, and

Optical fiber communication: optical fiber communication takes light wave as an information carrier and optical fiber as a transmission

ABSTRACT modern optical communication systems. In recent years, significant research efforts have focused on mitigating its impact

This paper explores the emergence of fiber-optic tethered drone technologies as a resilient alternative that significantly

Multi-path interference (MPI) arising out of multiple optical reflections from fiber connectors, transmitters and receivers is one optical

The multi-channel fiber optic communication network, crucial for long-distance digital signal transmission, faces linear

X.E Optical Fibers Optical fibers have become the preferred medium for terrestrial communication because they can carry gigabits of

Introduction Inter-channel nonlinear interference is arguably the most important factor in limiting the performance of fiber-optic

An improved differential cross-multiplication algorithm and cross-correlation algorithm are proposed for vibration

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