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CPFSK-Modulated Soliton-Based Ultra-Long-Distance Laser Synchronization for Secure Optical Communications

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Abstract: - Abstract We propose a novel ultra-long-distance synchronization method for semiconductor lasers, using CPFSK-modulated soliton pulses as the common drive signal. This approach leverages the stability of solitons in long-haul fiber transmission and the continuous phase of CPFSK modulation for reliable synchronization. Experimental results demonstrate synchronization of distributed feedback lasers over an 8191-km fiber link, outperforming traditional chaos-based methods by achieving an 8-fold increase in transmission distance without requiring complex compensation hardware. Additionally, our method preserves communication capacity by avoiding the need for a dedicated channel for analog drive signals, offering a promising solution for secure, high-performance optical communication in backbone and submarine networks.

Keywords: *CPFSK modulation, Soliton pulses, Ultra-long-distance synchronization, Semiconductor lasers, Fiber-optic communication, Secure optical transmission.*

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