Optical Encryption Based on Cancellation of Analog Noise

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Abstract: We propose an optical encryption technique where the data is encrypted with wideband analog noise. Matching both the phase and amplitude of the noise is required, providing a large key space for the encryption process.
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1. Introduction

Optical encryption provides an effective way to secure data transmission without compromising the bandwidth [1,2]. Different optical encryption methods have been studied, including optical XOR logic encryption [3] and optical chaotic encryption [4]. Although optical XOR logic can reach 20Gb/s [3], the encrypted data is a digital signal. Compared with analog noise, the digital signal leaves the original data undamaged, and once the eavesdropper knows the code for the encryption, he can still recover the original data from the encrypted digital signal. Optical chaotic encryption encrypts the data with noise-like analog signals; however, it requires the laser at the transmitter and receiver to be synchronized to recover the data. The synchronization parameters cannot be directly used as key distribution for encryption process. A high speed encryption method with both analog noise signal carrier and easily tunable parameters for large key space is required.

Optical interference cancellation techniques have been widely studied to remove self-interference in wireless communication systems [5,6]. The most challenging problem of optical interference cancellation is to satisfy the matching condition between the interference path and the cancellation path. The challenging problem in optical interference cancellation can be used as an advantage for the optical encryption, because the precise requirement of the matching condition provides a large key space to the encryption process.

In this paper, we propose and experimentally demonstrate an optical encryption method based on interference cancellation. The digital signals ar

3. Experiment results and analysis

The RF spectrum response measurement shows that if the matching conditions are satisfied, the noise encryption system can cancel noise with bandwidth 1GHz at a central frequency of 5GHz by at least 25dB (Fig. 2). The noise cancelled spectrum is measured when signal is turn off and noise in