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Partial M-Sequence Code Families Applied in Spectral Amplitude Coding Fiber-Optic Code-Division Multiple-Access Networks

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Abstract : Nowadays, numerous spectral amplitude coding (SAC) fiber-optic code-division-multiple-access (FO-CDMA) techniques were appealing due to their capable of providing moderate security and relieving the effects of multiuser interference (MUI). Nonetheless, the performance of the previous network is degraded due to fixed in-phase cross-correlation (IPCC) value. Based on the above problems, a new SAC FO-CDMA network using partial M-sequence (PMS) code is presented in this study. Because the proposed PMS code is originated from M-sequence code, the system using the PMS code could effectively suppress the effects of MUI. In addition, two-code keying (TCK) scheme can applied in the proposed SAC FO-CDMA network and enhance the whole network performance. According to the consideration of system flexibility, simple optical encoders/decoders (codecs) using fiber Bragg gratings (FBGs) were also developed. First, we constructed a diagram of the SAC FO-CDMA network, including (N/2-1) optical transmitters, (N/2-1) optical receivers, and one N×N star coupler for broadcasting transmitted optical signals to arrive at the input port of each optical receiver. Note that the parameter N for the PMS code was the code length. In addition, the proposed SAC network was using superluminescent diodes (SLDs) as light sources, which then can save a lot of system cost compared with the other FO-CDMA methods. For the design of each optical transmitter, it is composed of an SLD, one optical switch, and two optical encoders according to assigned PMS codewords. On the other hand, each optical receivers includes a 1 × 2 splitter, two optical decoders, and one balanced photodiode for mitigating the effect of MUI. In order to simplify the next analysis, the some assumptions were used. First, the unipolarized SLD has flat power spectral density (PSD). Second, the received optical power at the input port of each optical receiver is the same. Third, all photodiodes in the proposed network have the same electrical properties. Fourth, transmitting '1' and '0' has an equal probability. Subsequently, by taking the factors of phase-induced intensity noise (PIIN) and thermal noise, the corresponding performance was displayed and compared with the performance of the previous SAC FO-CDMA networks. From the numerical result, it shows that the proposed network improved about 25% performance than that using other codes at BER=10-9. This is because the effect of PIIN was effectively mitigated and the received power was enhanced by two times. As a result, the SAC FO-CDMA network using PMS codes has an opportunity to apply in applications of the next-generation optical network.

Keywords : spectral amplitude coding, SAC, fiber-optic code-division multiple-access, FO-CDMA, partial M-sequence, PMS code, fiber Bragg grating, FBG
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