

Time-Interleaved Multi-Channel All-Optical Regeneration Based on Higher-Order Four- Wave Mixing

Mohd Shah Nor Shahida Masayuki Matsumoto

Distorted optical signals can be refined by a higher-order FWM based all-optical regeneration [1,2]. However, all of the studies on this regeneration method reported so far concern only for single-channel application. In Ref. [3], multi-wavelength channels can be simultaneously regenerated without mutual interaction when they are suitably time-interleaved. Here, time-interleaving is used in all-optical regeneration of two-wavelength channels based on higher-order FWM in fibers.

TWO-CHANNEL ALL-OPTICAL REGENERATION

The structure of this regenerator is the same as a single-pump parametric amplifier, which consist of a pump and a highly nonlinear fiber (HNLf) [1]. In our experiment, a 10Gbit/s on-off keyed short RZ pulse train is modulated with 7GHz RF tone to simulate amplitude noise and then sliced into two channels that have wavelengths of 1555.5nm (ch1) and 1556.7nm (ch2). The channels are decorrelated and time interleaved before being inserted into a HNLf together with a continuous-wave pump. The pump power and wavelength are 70mW and 1561nm, respectively. The HNLf has zero-dispersion wavelength of 1556nm, dispersion slope of 0.026ps/nm²/km, nonlinearity of $\sim 12\text{W}^{-1}\text{km}^{-1}$, loss of 0.78dB/km, and length of 1.5km. As the FWM process in fibers has an ultrashort response time, interaction between multi-wavelength pulses separated in time by more than several picoseconds can be suppressed. Second-order FWM products at wavelengths 1550.0nm (ch1) and 1552.4nm (ch2) are extracted as the output signals via optical bandpass filters. Second-order products are selected so that the output power initially increases quadratically and then saturates as the input power increases, with which noise on the mark level is suppressed while buildup of space-level noise is avoided [1,2].

Fig. 1 shows BER curves before and after the regeneration when the two channels are time separated by 50ps. The receiver sensitivity is improved about 2.5dB by the regeneration. Corresponding pulse waveforms illustrated in Fig. 2 show suppression of mark level noise and no degradation of extinction ratio by the regeneration process.

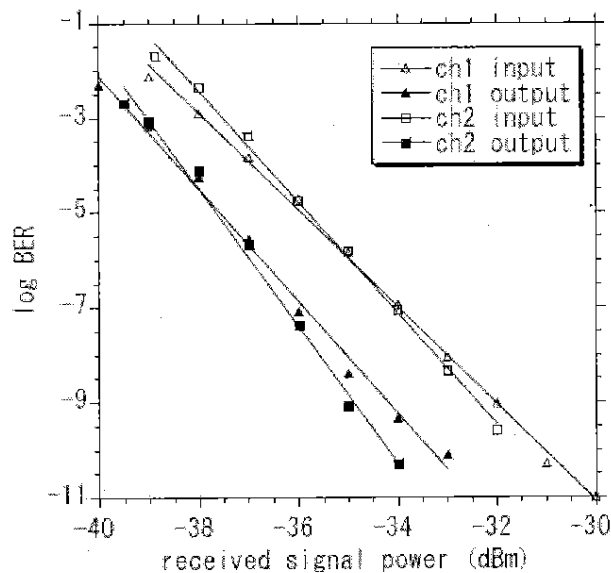


Fig. 1 BER vs received power of ch1 and ch2.

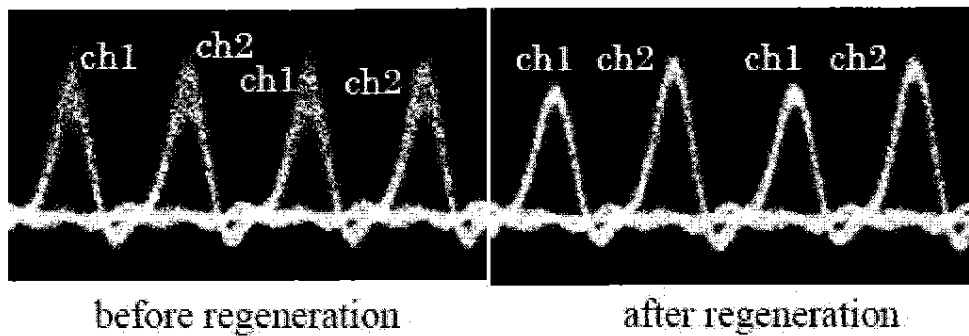


Fig. 2 Pulse waveforms before and after the regeneration.

CONCLUSION

Properly time-interleaved two-wavelength channels are effectively regenerated using higher-order FWM in a single HNLF. Maximum number of channels that can be regenerated and how to achieve time-interleaving of asynchronous signals are subject for future studies.

REFERENCES

- [1] E. Ciaramella and S. Trillo: IEEE Photonics Technol. Lett. 12 (2000) 849.
- [2] K. Inoue: IEEE Photonics Technol. Lett. 13 (2001) 338.
- [3] N. Chi, L. Xu, K. S. Berg, T. Tökle, and P. Jeppesen: IEEE Photonics Technol. Lett. 14 (2002) 1581.