Semiconductor-based all-optical wavelength conversion with long-pattern 200-Gb/s waveform monitoring technique

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Ultrafast all-optical signal processing has been extensively studied for its potential to eliminate optical-electrical-optical conversion in packet-node switching and reduce total cost and power consumption of future broadband optical networks. Among several kinds of all-optical processors, those using semiconductor optical amplifiers (SOAs) as ultrafast optical-modulation media have been highly expected for many practical advantages as low control signal energy (10~100 fJ), high reliability, signal polarization insensitivity, and potential integrability. Their ability for ultrafast signal-wavelength conversion has been already demonstrated for operation frequencies of 160~320 Gb/s, when combined with a delayed interferometer or an wavelength-shifted bandpass filter [1,2]. It has been recognized, however, that such high-frequency operation is not possible unless fine adjustments of various operation parameters including seed cw-light polarization are performed. We have speculated that the primary causes of errors are data-pattern-dependent intensity noises and sub-pulse noises [3], though nobody has succeeded in establishing a clear cause. This is presumably because currently-used methods for signal monitoring are limited to eye diagram measurement with an optical sampling scope and bit-error-rate measurement after time-division demultiplexing. Instead of these methods, accurate bit-by-bit monitoring of the output signals under practical, long-bit-pattern data operation will be a powerful tool for the investigation of the pattern noises and sub-pulse noises.

To realize such long-period, high resolution waveform monitoring we developed a low-frequency (40-MHz) optical sampling system, which is synchronized to 200 Gb/s ultrafast optical signals with low-timing jitter (fig 1). We used the 40-MHz pulses for the reference of a cross correlator. Then we succeeded in monitoring arbitrary portion of 4992-bit, 200-Gb/s optical input signals with picosecond-scale time resolution (fig 2(a)). Also conventional eye-diagram could be obtained from measurred waveforms, which shows clear eye-openings (fig 2(b)). Analysis of the ultrafast wavelength conversion in the SOA gate with this method is ongoing, and its results will be presented.

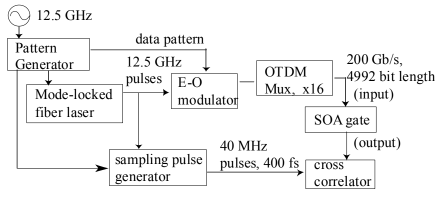

Fig. 1. Schematic diagram of the experimental setup

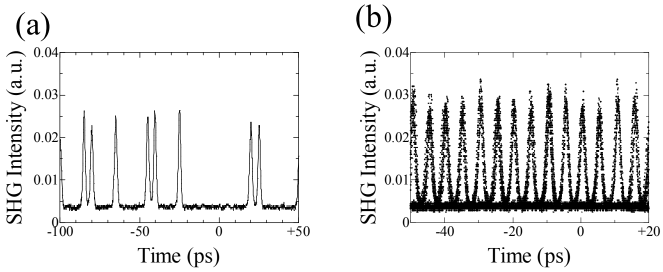

Fig. 2. Measured waveform of the 200 Gb/s optical signals

(a): bit-by-bit, (b): eye diagram

References

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