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# All-Optical TDM Demultiplexing Systems with Significant Timing Jitter Tolerance through Incorporation of Square Pulse Generating Fiber Bragg Gratings

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As OTDM data rates increase, and the pulses used get correspondingly shorter, the synchronization requirements placed on the locally generated pulses used to control the switch operation can become a limiting practical issue. The key to reducing time jitter tolerance in such devices is to establish a rectangular temporal switching window [1]. This reduces the absolute accuracy for temporal bit alignment and provides optimal resilience to timing jitter-induced errors.

In this paper we report the use of superstructured fiber Bragg gratings (SSFBGs) to convert the output of an actively mode-locked, 2.5ps fiber laser, a reliable source of short pulses of a well-defined soliton shape, to 20ps square pulses [2]. These pulses are then used to control the operation of two sorts of nonlinear switch. High quality, ~15-20ps rectangular switching windows are obtained, providing +/-7ps, 15ps timing jitter tolerance, in switches based on both the Kerr effect in dispersion shifted fiber (nonlinear optical loop mirror (NOLM)), and on four-wave mixing in a semiconductor amplifier (SOA). This approach is particularly attractive for use with SOA based switching devices for which there is no ready way of shaping the switching window other than through direct control of the pulse shape

[1] K. Uchiyama, T. Morioka, S. Kawanishi, H. Takara, and M. Saruwatari, "Signal-to-noise ratio analysis of 100Gb/s demultiplexing using nonlinear optical loop mirror," *J. Lightwave Technol.*, vol.15, pp.194-201, 1997.
[2] P. Petropoulos, M. Ibsen, A. D. Ellis, and D. J. Richardson, "Rectangular pulse generation based on pulse reshaping using a superstructured fiber Bragg gratings," *J. Lightwave Technol.*, vol.19, no.5, pp.746-752, 2001.

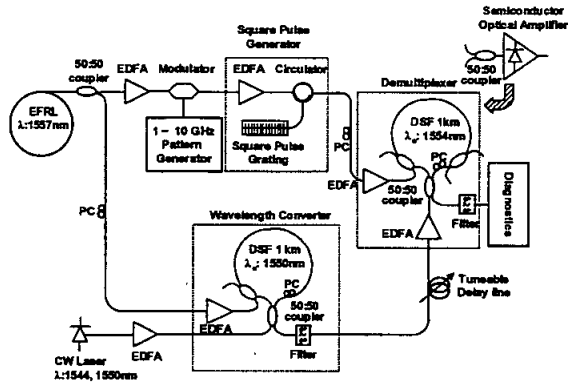
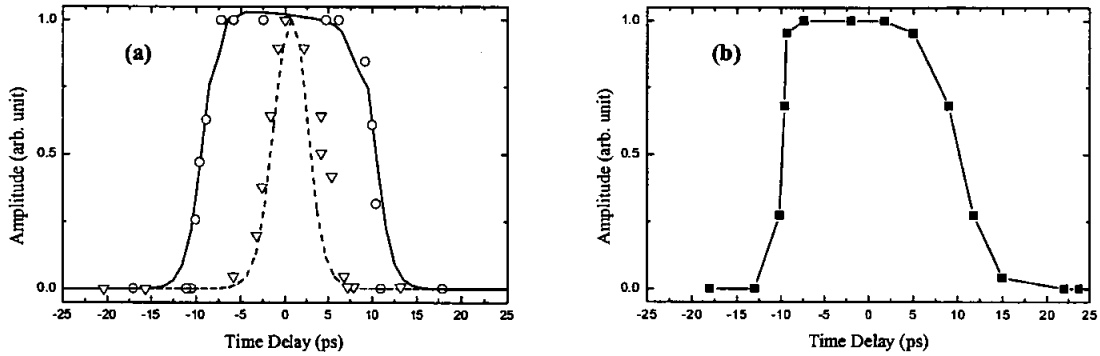



Fig. 1: Experimental setup




Fg.2: Switching windows of (a) the NOLM based OTDM demultiplexer with respect to relative timing mismatch between control pulses and data pulses; solid line (—): calculation for square control pulses, dashed line (---): calculation for soliton control pulses, circle (O): experiment for square control pulses, triangle (▽): experiment for soliton control pulses and (b) experimentally determined SOA based switch switching window.

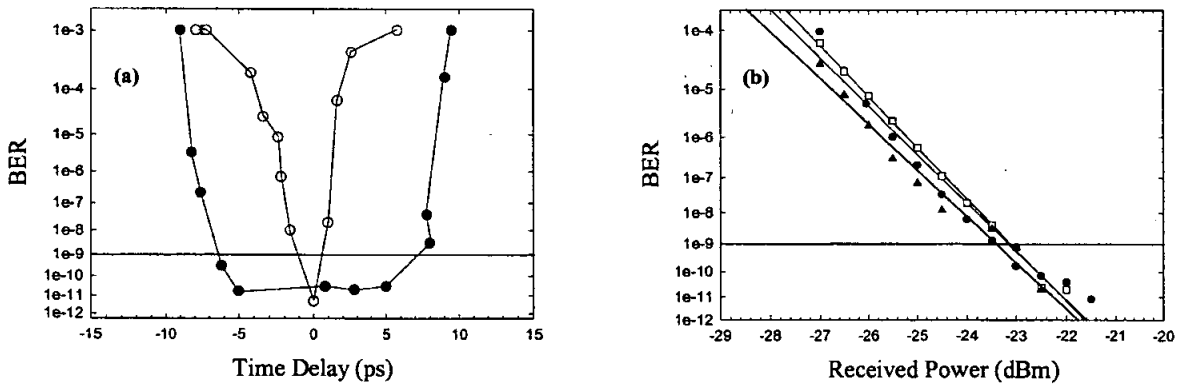



Fig.3: BER on the optically modulated signals; (a) at the fixed received power of -20dBm (●: 20ps square control pulses, O: 2.5ps soliton control pulses), (b) under optimal time synchronization between control pulses and data pulses (□: wavelength converted signal, ●: switched output using 20ps square control pulses ▲: switched output using 2.5ps soliton control pulses).