Small digital device creates variable time delay between polarizations

By Sunny Bains

A new electronic device allows the time delay between orthogonally polarized beams to be tuned in less than a millisecond with a resolution of just over a picosecond (and higher resolutions possible). Developed by researchers at General Photonics Corp. (Chino, CA), the current prototype allows tuning from -45 to +45 ps using a digital interface and can be used dynamically (with constant switching) with little loss caused by transients. It's inventors say the device can be used to emulate various polarization-mode dispersion conditions (in order to test system performance), as well as dynamically compensating for such dispersion, allowing bit alignment in time-division multiplexing and beam-forming in true-time-delay phased-array radar systems.

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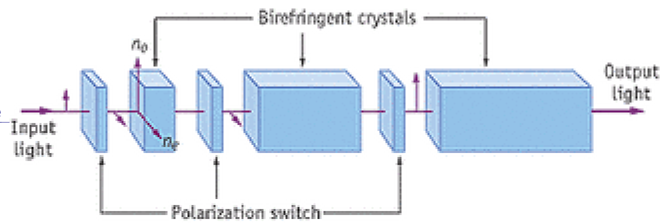

The new General Photonics system allows the delay between orthogonal polarizations of light to be varied digitally. Each polarization switch controls how the two beams experience delay in the following birefringent crystal. The delay itself is set by the length of the crystal, which is determined by its bit value (from least- to most-significant bit). Only three bits are shown here, but there are six in the current device.

The system exploits polarization switching that takes place before the combined beam enters each of a series of birefringent crystals (see figure).[1] The crystals have different lengths, mathematically calculated so that each represents a time delay from least-significant to most-significant bit (the current device is a 6-bit system). A magneto-optic polarization switch rotates the incoming light to choose which of the two orthogonally polarized beams experiences the time delay, and which does not. Thus, the delay between the two polarizations is determined by digitally specifying the state of the six switches.

As well as confirming that the device could accurately produce the required differential delays with low loss in static situations, dynamic performance was also considered. In one experiment they were able to demonstrate that switching transients were always less than the delay step size. Thus, at any moment, the device can have an error of at most one grey-level. Likewise, the device performed well in a fast-switching situation: with a 10-Gbit/s signal and a control signal varying between neighboring states at 1 kHz (with a period just above the maximum device switching speed of 0.6 ms). Overall the worst-case power penalty was less than 2.5 dB.

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REFERENCE

1. L.-S. Yan et al., OFC 2002, postdeadline paper FA5-1.

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