High Speed Photonic Digital-To-Analog Conversion (Ramot)

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The Technology

A novel integrated optical modulator based on a multi-electrode Mach-Zehnder modulator has been developed at Tel-Aviv University. The device has superior performance in terms of linearity, dynamic range and implementation simplicity. These improvements are achieved by utilizing a unique mapping method between the analog input and the digital sequence applied to the device, and by an optimized sectioning method for the electrodes. Further improvement in linearity is attained by allowing the number of electrodes M to be larger than the number of digitization bits N (M>N).

The modulator can be used to generate M-ary signal constellations, such as optical 64QAM, for advanced coherent optical communication. It is characterized by a direct digital drive approach whereby the digital input can be connected directly to the optics. The required target performance, be it transmitter EVM or receiver BER, can be used for determining the best electrode setting on the arms of the modulator. An obvious advantage is that it can increase the data throughput without the need for upgrading existing basic component hardware technology (detectors, transmission lines, etc.)

The modulator can also be used as a photonic digital-to-analog converter, replacing existing all-electronic solutions. The device accepts digital words at GS/s rates and produces a wideband analog signal at its output. The D/A achieves a superior linearity at its output, along its entire operating spectrum.

The Need

It is a consensus nowadays, that the only way to cope with the throughput increase in data links is by fully exploiting the capacity of optical communication channels. Traditionally, optical communication systems have predominantly used some form of on/off keying which allowed the transmission of one data bit per each time unit. The growing demand for greater capacity in optical communication systems calls for an increase in transmission speed from 10 Gbps to 100 Gbps and beyond. Multilevel optical modulators are key devices in achieving these target rates.

Advantages

The product is characterized by high speed, high bandwidth, high accuracy, small size, and low cost in comparison to current available digital- to-analog converters and optical modulators.

Potential Applications

The final product expected is a high speed integrated chip optical modulator for generating complex multi-level signals for optical communication and signal generation.

Possible end users include companies that manufacture the following products: optical communication systems, optical interconnect, data centers, fiber-to-the-home, airborne, space, and ground radar systems and ground-, air-, and space-based communication systems. Likewise, companies that manufacture components for the abovementioned products are promising candidates. Of particular value is the application of the proposed device for emerging optical OFDM systems which are very sensitive to linearity, as well as peak-to-average power issues.

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