Arbitrary waveform generator and differentiator employing an integrated optical pulse shaper

We propose and demonstrate an optical arbitrary waveform generator and high-order photonic differentiator based on a four-tap finite impulse response (FIR) silicon-on-insulator (SOI) on-chip circuit. Based on amplitude and phase modulation of each tap controlled by thermal heaters, we obtain several typical waveforms such as triangular waveform, sawtooth waveform, square waveform and Gaussian waveform, etc., assisted by an optical frequency comb injection. Unlike other proposed schemes, our scheme does not require a spectral disperser which is difficult to fabricate on chip with high resolution. In addition, we demonstrate first-, second- and third-order differentiators based on the optical pulse shaper. Our scheme can switch the differentiator patterns from first- to third-order freely. In addition, our scheme has distinct advantages of compactness, capability for integration with electronics.