Polarization maintaining pulse interleaving for low noise photonic microwave generation

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Here we present a study on the impact of pulse interleaving on the spectral purity of microwave signals generated by photodetection of a passively mode-locked diode-pumped solid-state laser emitting at ~1560 nm with a pulse repetition rate of f_r = 100 MHz and a pulse duration of ~150 fs. The photodetection is performed by means of a commercial photodiode (Discovery Semiconductors, bandwidth 23 GHz). The interleaver consists of up to n = 5 cascaded Mach-Zehnder interferometers made of spliced polarization maintaining fiber beam-splitters (50/50) and terminated by a beam recombiner leading to a maximum multiplication factor of $2^5 = 32$. Phase noise measurements are performed on different carriers at harmonics of the interleaver output frequencies of $2^n \cdot f_r$ in a frequency range of 5-15 GHz, with the optical power tuned just below photodetector saturation. The effect of delay length and splitting ratio errors in the interleaver stages on the phase noise and power at a given microwave carrier frequency are simulated with a model and experimental results are compared with recent literature[1]. The advantages of using a polarization maintaining interleaver will also be discussed.

[1] F. Quinlan et al., http://arxiv.org/abs/1312.1997