Opto-Electronics Review, 2016, volume 24, issue 2, pp. 62-74

Optical waveform monitoring based on a free-running mode-locked femtosecond fibre laser and four-wave mixing in a highly nonlinear fibre

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DOI: https://doi.org/10.1515/oere-2016-0010

Abstract:

Optical sampling based on ultrafast optical nonlinearities is a useful technique to monitor the waveforms of ultrashort optical pulses. In this paper, we present a new implementation of optical waveform sampling systems by employing our newly constructed free–running mode–locked fibre laser with a tunable repetition rate and a low timing jitter, an all–optical waveform sampler with a highly nonlinear fibre (HNLF), and our developed computer algorithm for optical waveform display and measurement, respectively. Using a femtosecond fibre laser to generate the highly stable optical sampling pulses and exploiting the four–wave mixing effect in a 100m–long HNLF, we successfully demonstrate the all–optical waveform sampling of a 10GHz optical clock pulse sequence with a pulse width of 1.8 ps and a 80Gbit/s optical data signal, respectively. The experimental results show that waveforms of the tested optical pulse signals are accurately reproduced with a pulse width of 2.0 ps. This corresponds to a temporal resolution of 0.87 ps for optical waveform measurement. Moreover, the optical eye diagram of a 10Gbit/s optical data signal with a 1.8 ps pulse width is also accurately measured by employing our developed optical sampling system.