

Data transfer by spectral encoding method with high-power pulsed terahertz source

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Frequency comb in terahertz spectrum with element bandwidth of 0.03 THz utilizing high-power pulsed source are obtained. Data encoding and transmission via terahertz frequency comb are demonstrated. Information encoded in frequency comb by Si plate filter transferred on 60 cm in spectrum of two terahertz pulses.

I. TERAHERTZ COMMUNICATION

THz communications will allow achieving remarkable data rates in the wireless links. We had developed data encoding method and equipment employing broadband pulsed terahertz sources. Information encoding was performed by the original method [1] in each broadband THz pulse spectrum as well as in a pulse train.

II. EXPERIMENT AND RESULTS

A femtosecond laser pulse of duration 37 fs at 820 nm with a 1 kHz repetition rate is used to generate and detect THz pulses in MgO:LiNbO₃ [2]. The input pulse is shaped by a one side moving Michelson interferometer and becomes a new pulse composition which consists of two pulses. The time interval between these two pulses can be changed. Frequency comb formed in THz spectrum by two femtosecond pulses with time interval of 30 ps between them have elements bandwidth of 0.03 THz (Fig. 1.)

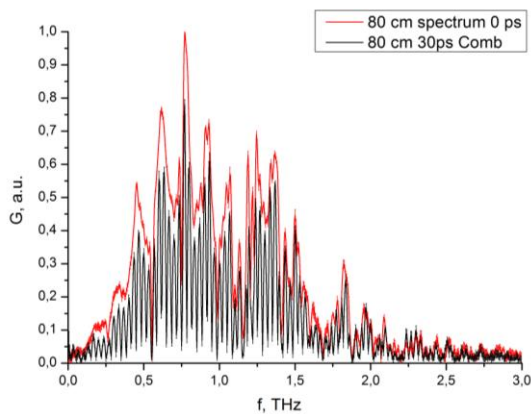


Fig. 1. Frequency comb formed by two femtosecond pulses separated by 30 ps (black line) and reference terahertz spectrum (red line).

We choose information transfer band of 0.4 to 1.0 THz to work in low water absorption range (Fig. 2.) There we got seventeen comb elements suitable for data encoding.

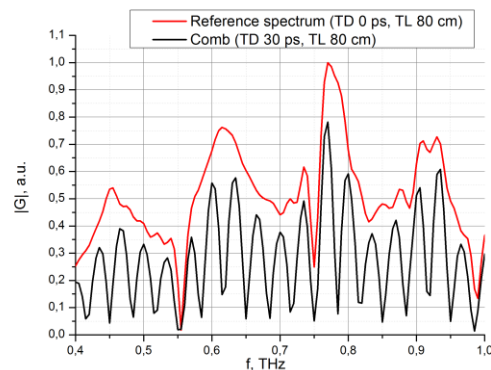


Fig. 2. Working range of frequency comb formed by two femtosecond pulses separated by 30 ps (black line) and reference terahertz spectrum (red line).

We used a high resistance silicon wafer of 1 mm thickness as encoding device to demonstrate the transmission of information. Parallel surfaces of plate performing Fabry-Perot interferometer with transmission function presented on Fig. 3.

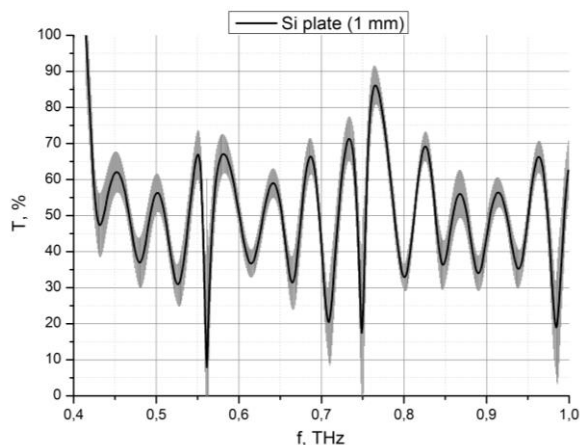


Fig. 3. Transmission function of encoding device.

The imposition of the transmission function of the filter and function of the frequency combs have been implemented coding of information. Fig. 4. shows the normalized spectral envelope of a single pulse source and coded signals at the input of the transmission channel information.

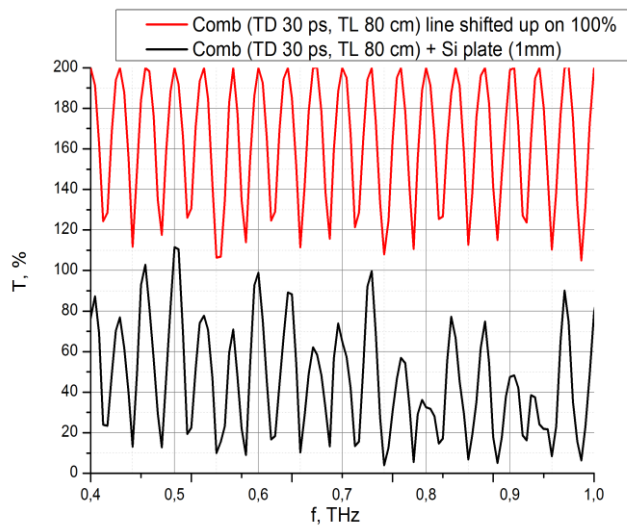


Fig. 4. Spectra of the original (top) and coded (bottom) of the signal at the input of the information channel.

After that the optical path of the probe beam and terahertz been extended by 60 cm to record the signal at the output of information channel. Signals transmitted in ambient air strongly attenuated due to the high absorption of water vapor, thus, the channel with low losses may be significantly longer. Signals measured at the input and output of the channel information shown in Fig. 5. It is seen full coincidence signal amplitude taking into account the 20% error induced by the encoder device.

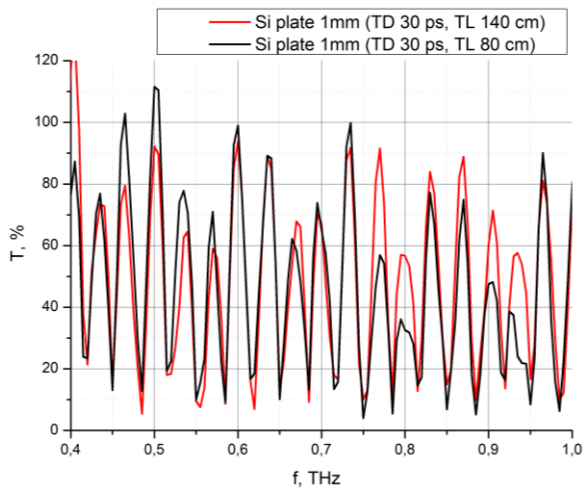


Fig. 5. The spectra of the encoded signal at the input (black) and output (red) of information channel.

III. SUMMARY

In summary data encoding and transmission via terahertz frequency comb formed by Michelson interferometer in high-power terahertz source are demonstrated. Information encoded by Si plate filter and transferred on 60 cm in spectrum of two terahertz pulses.

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