Reply to "Comment on 'Time reversal of ultrafast waveforms by wave mixing spectrally decomposed waves'"

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Received May 12, 2000

In response to a comment on our Letter [Opt. Lett. **25,** 132 (2000)], we reiterate the distinction between the spectral inversion and the spectral phase conjugation processing techniques. The former achieves time reversal of the complex amplitude waveform, whereas the latter performs time reversal of the real electric field. © 2000 Optical Society of America

OCIS codes: 320.0320, 320.5540, 320.7110, 070.4340, 190.5040, 190.4380.

The comment by Weiner on our Letter on time reversal of ultrafast waveforms[1] supports, rather than contradicts, our original statements and conclusions. As described in the Letter we performed two different manifestations of time-reversal experiments in real time by use of four-wave mixing with cascaded second-order nonlinearities. We demonstrated, compared, and contrasted the techniques of spectral information inversion (SI) and spectral phase conjugation (SPC) for time reversal of ultrafast waveforms. We claimed that the SI technique achieves true time reversal of complex amplitude ultrafast waveforms.

Let us borrow the definition of the real electric field, as expressed by Eq. (1) in the comment. Then $s(t)$ describes the complex amplitude waveform (or envelope) of the ultrafast signal. The SI technique achieves true time reversal of this complex waveform by reversing both the amplitude and the phase of the waveform [by replacing t with $-t$ in $s(t)$]. This is different from time reversal of the electric field [by replacement of t with $-t$ in $e_{\text{in}}(t)$], which is achievable by use of the SPC technique. Our analysis showed that time reversal of the electric field reverses and conjugates the complex amplitude waveform [transforming $s(t)$ to $s^*(-t)$], consistent with reports in other publications.[2,3] As example (2) of Weiner's Comment indicates, dispersion compensation is achieved when time reversal of the electric field is implemented between two identical dispersive media.

In summary, the SI technique reverses the complex amplitude waveform, whereas the SPC technique reverses the electric field. The interested reader is referred to Ref. 2 for a broader discussion of the phase information in time reversal of complex amplitude waveforms.

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