Characterization of octave-spanning continuum generated from multiple SiO_2 plates.

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Polarization-gating cross-correlation frequency-resolved optical gating (PGX FROG) is used to characterize an octave-spanning visible spectrum generated from a set of multiple fused silica plates developed in our laboratory.

Recently our laboratory developed a new technique to generate ultrashort pulses that have an octave-spanning continuous spectrum using a set of multiple fused silica plates (MP Continuum) [1]. The ultrabroad spectrum of these pulses creates a significant challenge to pulse characterization which normally suffers from the limited phase-matching bandwidth of SHG or SFG FROG or SPIDER. The complex structure present in both the temporal and the spectral domains in supercontinuum pulses also leads to complex and fragmented FROG/SPIDER traces [2]. On the other hand, with polarization gating one can achieve essentially infinite bandwidth. With an intense gate pulse, it is possible to record pulses with a complex spectrum [3]. We have used polarization-gating cross-correlation frequency resolved optical gating (PGX-FROG) with an intense reference pulse to retrieve the spectral phase and amplitude of the MP Continuum generated in our laboratory. The result is shown in figure 1. The retrieved spectrum is in reasonable agreement with that measured with a spectrometer (Ocean Optics HR4000). From the retrieved spectral intensity and phase we obtained the temporal shape. The temporal shape of the pulse indicates that the pulse is heavily chirped to a FWHM of 98 fs and a 10% with of about 400 fs. The group velocity dispersion is calculated from the spectral phase to be 180 fs^2 at 700 nm. With these results we can begin to work on compressing the pulse to its transform limit. To summarize, we have demonstrated that PGX-FROG is useful for full characterization of octave-spanning MP Continuum pulses. Future plans include modifying the system for single-shot characterization, and employing the technique to monitor the compression of these pulses.

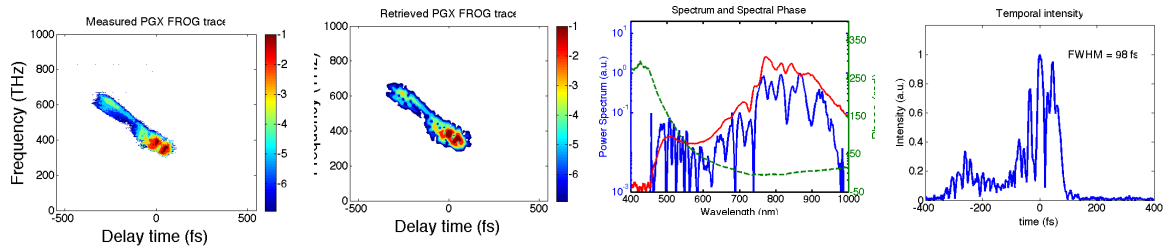

Figure 1: from left to right: measured PGX-FROG trace, retrieved PGX FROG trace, retrieved spectral intensity (blue) and phase (green) and spectrum recorded with a spectrometer (red), and retrieved temporal shape of the MP Continuum pulse.

[1] Chih-Hsuan Lu et. al., "A new and improved approach to supercontinuum generation in solids," paper STh1E.6, CLEO 2014, June 8-13, 2014.
[2] R. Trebino, Frequency-Resolved Optical Gating: The Measurement of Ultrashort Laser Pulses (Kluwer Academic Publishers, 2002).
[3] T. C. Wong and R. Trebino, "Single-frame measurement of complex laser pulses tens of picoseconds long using pulse-front tilt in cross-correlation frequency-resolved optical gating," J. Opt. Soc. Am. B 3 0 (11), 2781-2786 (2013).