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Characterization of infrared pulses using upconversion

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Abstract: We demonstrate and discuss the advantages of a novel system performing time resolved spectral characterization of mid-infrared supercontinuum pulses using electronically synchronized delay-tuned pulsed upconversion.

OCIS codes: (190.7220) Upconversion; (300.6340) Spectroscopy, infrared

The use of pulsed mid-infrared sources like supercontinuum sources and quantum cascade lasers is becoming ever more popular in a variety of spectrometric optical systems for detection, identification, and/or quantification of chemical species. It is however critical to characterize their temporal profile as well as the spectral variation within the duration of a pulse to ensure the best possible accuracy, resolution and repeatability of such measurements. This task is complicated as there are to this day no commercial systems available for the characterizing time resolved spectra of mid-infrared sources.

Fig. 1 Schematic of upconversion setup

We present a novel system performing measurements of the temporal profile and time resolved spectra of mid-infrared supercontinuum pulses from a Mid-IR SuperK Compact source from NKT using an electronically synchronized and delay-tuned pulsed upconversion setup of which a schematic is presented in **fig. 1**. The supercontinuum ranges from 2 μm to 4.5 μm and emits 1.2 ns pulses at 40 kHz that are focused inside a bulk lithium niobate crystal. In this crystal, the supercontinuum pulses are mixed with sub-200 ps 1064 nm pulses from a gain switched diode seeded MOPA which acts as the pump for the upconversion process. Both sources are triggered electronically using a T560 pulse delay generator from Highland Technology and their relative delay can be tuned in with a precision of less than 45 ps. The temporal and spatial overlap of the supercontinuum and 1064 nm pulses leads to sum frequency generation in the spectral range of 690 nm to 860 nm. We characterize the supercontinuum pulses by delay tuning the 1064 nm pulses and measuring the upconverted signal on a silicon-based camera. The measurements allow us to reconstruct spectrograms as presented in **fig. 2**.

Fig. 2 Spectrogram of supercontinuum pulse

The electronic pulse delay generator has the advantage of not requiring any mechanical delay lines [1]. This is especially an advantage when probing longer timescales i.e. tens of ns or longer as this would require a long delay arm. Additionally, the use of a gain switched diode seeded MOPA enables measurements with temporal jitter 2 orders of magnitude lower than observed in previous similar work [2].

References

- [1] J. Ramsay "Generation of infrared supercontinuum radiation: spatial mode dispersion and higher-order mode propagation in ZBLAN step-index fibers," *Opt. Express* **21**, 10764-10771 (2013)
- [2] J-M. Melkonian "Time-resolved spectral characterization of a pulsed external-cavity quantum cascade lasers", *Optics and Photonics for Counterterrorism, Crime Fighting, and Defence VIII*, SPIE Proceedings Volume 8546; 854607 (2012); doi: 10.1117/12.971429