Canadian Association of Physicists

Association canadienne des physiciens et physiciennes

Contribution ID: **3320** Type: **Oral not-in-competition (Graduate Student) / Orale non-compétitive (Étudiant(e) du 2e ou 3e cycle)**

Rapid Ultrashort Pulse Characterization using Neural Networks

Monday 6 June 2022 16:15 (15 minutes)

Ultrashort femtosecond to attosecond laser pulses of electromagnetic radiation are an essential tool for measuring ultrafast phenomena. Such pulses due to their short duration, can have high intensity and minimal heat transfer. When working with ultrashort pulses it is crucial to characterize them by determining their amplitude and phase. There are numerous methods to characterize these pulses. Frequency resolved optical gating (FROG) is one method which is widely used to characterize ultrashort pulses. The FROG trace obtained through measurement of an ultrashort pulse is processed to obtain the phase and intensity of the pulse. Conventional processing methods generally require a full spectrogram and are iterative, taking several seconds to execute. A computationally efficient signal analysis method, based on convolutional neural networks, has been developed to provide fast ultrashort pulse characterization with low signal-to-noise ratio and without a full spectrogram.

Deep learning with neural networks is a technique for solving complex nonlinear problems. Convolutional neural networks were optimized to invert the FROG trace to obtain the pulse amplitude and phase. Simulations were used to train the network based on pulses of different widths passing through a dispersive medium with up to fourth order dispersion. Additional noise was added to the phase, to increase the diversity of sample pulse shapes, and to the FROG trace to improve robustness. The performance of this algorithm was evaluated on simulated FROG traces and compared to a conventional singular value decomposition method. The neural network was able to characterize pulses times three orders of magnitudes faster compared to the traditional method and does not requiring a full spectrogram to be sampled.

Primary author: PARASRAM, Tristhal

Co-authors: XIAO, Dan (University of Windsor); HAMMOND, TJ (University of Windsor)

Presenter: PARASRAM, Tristhal

Session Classification: M3-9 Atomic and Molecular Physics - Laser Spectroscopy (DAMOPC) | Physique atomique et moléculaire - spectroscope laser (DPAMPC)

Track Classification: Technical Sessions / Sessions techniques: Atomic, Molecular and Optical Physics, Canada / Physique atomique, moléculaire et photonique, Canada (DAMOPC-DPAMPC)