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Time-Frequency Representations of Ultra Short Laser Pulses for Coherent Control of Quantum Processes

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Abstract content
   (Max 300 words)

Historically the necessity for Time-Frequency Representations (TFR) has its origins in quantum mechanics. Gabor, in his seminal article on communication theory, recognised these quantum mechanical foundations of TFR's of time signals and there universal applicability. The Wigner representation and its dual, the ambiguity function are the classical examples. TFR and analysis has since grown into an enormous field and are classified in terms of Cohen classes and spawned the modern theory of wavelets.
The plethora of techniques is due to the Heisenberg uncertainty principle and the reciprocity of the Nyquist-Shannon sampling theorem. The Short Time Fourier Transform (STFT) and its prime candidate the spectrogram are often utilized as TFRs, but the shaping of ultra-short laser pulses for coherent control offer their own unique challenges. In the past few years coherent control of quantum processes have favoured the von Neumann representation. An overview of the quantum mechanical TFRs concentrating on the Wigner, von Neumann and Husimi representations is presented. Current research will be highlighted.

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