Multidimensional coherent spectroscopies: advanced spectroscopic techniques to unveil complex dynamics

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Femtosecond coherence spectroscopy is a family of ultrafast techniques that utilize ultrafast laser pulses to prepare and monitor coherent states in resonant or nonresonant samples. Among coherence spectroscopies, 2D electronic spectroscopy (2DES) techniques have recently gained particular interest given their capability of following ultrafast processes in real time. Indeed, 2DES is widely exploited nowadays to unveil subtle details of ultrafast relaxation dynamics, including energy and charge transport, in complex media such as biological and artificial light-harvesting complexes and solid-state materials. Particularly exciting is the possibility of assessing the presence of coherent mechanisms active in the transport of excitation energy in these materials. In this lecture, the main technical aspects of 2DES will be reviewed through the illustration of specific relevant applications to different materials. Current challenges and still debated perspectives will be presented.